Development of a Model for Health and Safety Management in Saudi Arabian Oil and Gas Construction Projects

Reem Alamri

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ABSTRACT

Health and safety is regarded as the foundation of the construction and production process in the oil and gas sector. However, in the Saudi Arabian oil and gas construction industry, this very foundation is threatened by the proliferation of work-related hazards that leave workers permanently or temporarily incapacitated. In comparison with other industrial sectors, workers on oil and gas construction sites are at greater risk of facing a variety of health and safety related risks, and that is the reason why it is essential to prevent the increasing level of accidents on these sites. Although, efforts were made to minimize exposure to such risks in the Saudi oil and gas sector, there is still a need for radical changes in the way the sector approaches health and safety issues. In this regard, this study examines the effectiveness of existing health and safety measures followed in Saudi Arabia, while looking at critical areas that require immediate attention as well as new measures that can be implemented to improve in those areas. To achieve this, both quantitative and qualitative research methods were used. For the quantitative research, questionnaires were designed and distributed to 300 respondents who work in construction companies in Saudi Arabia. For the purposes of obtaining answers from relevant respondents, construction companies who have experience from working on oil and gas construction projects were targeted. A total of 200 questionnaires were completed and returned. The quantitative data was analysed by descriptive and inferential statistics using Statistical Package for the Social Sciences (SPSS) software. For the qualitative data, semi-structured interviews were conducted with nine professionals purposely selected due to their knowledge, years of experience and familiarity with health and safety policies and standards on oil and gas construction sites. The analysis of the qualitative data was achieved using qualitative data analysis software QSR Nvivo. Duringqualitative

data analysis, thematic analysis was adopted to build themes from the data which formed the basis for the presentation of the results from this research. Findings from the research suggest that all participants are of the view that oil and gas construction projects have more health and safety issues compared to average construction projects. It was found that the nature of the oil and gas industry coupled with the risky nature of construction activities presented higher risk which led to increased health and safety issues when constructing in the sector. The results also indicated that there was a low level of involvement from the construction site teams and workers in the development of health and safety policies for oil and gas construction projects. It was also identified that there was very poor adherence to health and safety standards and regulations on oil and gas construction sites due to little or no understanding of requirements andprocedures, as well as the advantages of adhering to such. Poor enforcement of government legislation was also identified to be another major cause for the poor health and safety performance of oil and gas construction projects. Based on the aforementioned results and the findings obtained from literature, a framework was developed to ensure that health and safety was properly institutionalised throughout the processes undertaken by construction firms during project management. The framework recommends both corporate level and project level policies that could facilitate the adoption and implementation of health and safety guidelines on construction projects in the oil and gas sector. An implementation guide was equally presented alongside the framework in view that it would ensure that users covered all the necessary areas in terms of health and safety and that all parties were involved in the process. The research concludes that construction projects in the oil and gas sector are riskier and demand approaches and strategies specific to the type of projects undertaken. The study finally recommends that further research should be undertaken to

propose alternative models and national level legislative framework for enhanced health and safety guarantee especially in the Saudi oil and gas construction industry.

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CHAPTER ONE: INTRODUCTION

1.1 Introduction to Chapter One

The construction sector is defined as an industry that embraces materials and products, suppliers and producers, building services providers and installers, contractors, sub-contractors, professionals, advisors, clients and organisations that are relevant in the design, build operations and the maintenance of buildings (DTI, 2007). Specifically, the construction process utilises extensive labour, materials, plant equipment and resources (Harris, 1994). The aforementioned attributes indicate that construction is a complex process that is prone to work-related hazards due to the large number of activities that the process involves. When undertaking such complex work prone to hazards in the oil and gas industry, the situation is worsened due to the hazardous nature of the oil and gas industry. On average, the oil and gas industry is said to be dangerous due to the nature of the activities undertaken by the industry. Putting together two complex and hazard prone industries to deliver construction projects requires extra attention and measures to present negative consequences. In the light of this, this research focuses on the critical work-related hazards involved in construction projects in the oil and gas industry and measures for averting such risk.

1.2 Research Background

The construction site is regarded as a hazardous and high-risk environment where workers face a greater risk of work-related fatalities or injuries in comparison to workers in other industries (Ikpe, 2009). Construction is not a safe process by any measure (Everett *et al.*, 1996 and Gyi *et al.*, 1996) and as a result, the construction industry has an unenviable

reputation in relation to health, the safety and welfare of its workers (Egan, 1998 and Bomel, 2001). According to a report by the International Labour Organization, 270 million accidents occur at workplaces every year leading to 2.2 million deaths. Construction activities record the highest percentage of these incidents. Despite all the efforts to address the problem, the results have been far from satisfactory (Nwabueze, 2005). Around the world, the picture of accidents and deaths from the construction industry seems consistent although developed countries have lower rates than developing or underdeveloped countries. As reported in Pinto et al (2011), workers in the construction industry perform a great diversity of activities which expose them to risks from their own work as well as that of their co-workers.

The construction sector is considered to be one of the most dangerous due to the number of deaths recorded as a result of inadequate health and safety practices causing accidents (Tam *et al.*, 2004; Oloke *et al.*, 2007; Rozenfeld *et al.*, 2009; Mahmoudi et al., 2014). In the Saudi Arabian construction industry for instance, Fass et al (2017) report that the increase in construction activity has led to a rise in occupational injuries and accidents from construction activities. These accidents discourage workers, delay project progress, increase the overall cost, reduce productivity, and tarnish the public image of the industry (Thanwadee, 2009; Walsh and Sawhney, 2004; Sacks *et al.*, 2009). The prevention of accidents can significantly improve workers performance on the sites (Sacks *et al.*, 2005). A safe work practice is crucial to minimise accidents and achieve a reliable workflow in construction operations (Teo *et al.*, 2005; Schafer *et al.*, 2008). For oil and gas construction projects Berends (2007) reports that the high demand for increasingly complex projects make such construction projects risky with increased health and safety issues. This suggests that health and safety issues related to oil and gas projects may be

higher than those for other construction projects. The differences in the nature of risks and health and safety issues will demand the measures that are likely to be different from the general measures adopted to manage health and safety risks in construction projects.

1.3 Difficulties Encountered in the Construction Sector in Health and Safety Aspects

1.3.1 Construction Sector in Saudi Arabia

The constructions sector can be considered as one of the prime business sectors of developing countries, as it leads to producing large amounts of money and development opportunities within the country. Due to this, the well-developed and successful construction industry can be identified as one of the prime indicators of the potential of a country's economy. In regard to this notion, the research report presented by Deloitte (2013) has reflected that in Saudi Arabia, one of the most rapidly emerging economies within the country i.e. the construction industry, is currently booming. The total value of the construction industry in Saudi Arabia in the financial year 2013 accounted for approximately to USD 30bn, which shows a total annual growth of 4.5%.

In this context, Stellman (1998) stated that the increasing value of the construction industry made this sector and its related activities more structured and refined. Now different crucial aspects of organisational behaviour such as health policies, employee compensation, welfare programmes and safety related organisational norms can prove to be quite prominent phenomena in the context of health and safety within Saudi Arabia.

1.4 Context of the Research Work

The primary context of this research work is related to construction projects undertaken within the oil and gas sector, which dominates the business of many countries including Saudi Arabia. Currently, the country is ranked first among the world's major oil and gas producing countries (NSG, 2009). Saudi Arabia is considered one of the fastest growing countries in the Middle East. This high levels of growth can be attributed to a large extent, to the oil exploration and production from the country. The high levels of growth also come with the demand for more construction projects for the purposes of oil and gas activities and companies. These increase in construction projects, notwithstanding, the level of construction safety in the country, has been relatively low (Haadir and Panuwatwanich, 2011). The increase in oil production and the expansion in the contribution of the oil sector to the development of Saudi Arabia has been recognised as a very important factor in the nation's economy. This brings with it demands for construction projects to support the ever increasing oil and gas sector. Doing so requires construction projects that are both general in nature and specific to the demands of the oil and gas industry. Construction activities include the construction of offshore oil fields, gas corridors, gas pipelines, oil platforms production lines, accommodation, drilling facilities and oil refineries. Construction of projects of this nature increase the risks associated with general construction projects due to the environment these projects have to be undertaken in. Berends (2007) reports that the construction industry plays a key role in the development and implementation of Large Engineering and Construction Projects (LECPs) for oil and gas facilities.

Safety in construction in the developing countries including Saudi Arabia is particularly at a much lower level compared to developed countries due to the absence of strict

adherence to the existing regulations (Hinze, 1997). Particularly in Saudi Arabia, a survey shows that 25% of the contractors did not give new workers a safety orientation, 25% did not provide personal protective equipment, 25% did not provide first-aid and 38% had no trained safety personnel (Berger, 2008). Specifically, in the oil and gas industry, health and safety is the very foundation of the construction and production processes. The increased need for oil and gas related construction projects and the safety implication of these projects makes the need to improve health and safety during the construction of oil and gas related projects critical. It is essential to prevent the increasing number of accidents in oil and gas construction projects (Faniran, 2003). This is especially important as the nature of risks associated with oil and gas construction projects are quite different from those of general construction projects.

Critical risks in offshore and onshore oil and gas construction differ significantly from building construction, as the 'risk picture' is different (Chen, 2011).

Though there is a lot of progress on health and safety issues in the oil and gas sector, there is still a need for radical changes in the way the sector approaches health and safety improvements in its construction projects. Chen (2011) reports that despite the large number of studies on safety management in the construction industry, critical accident risks pertinent to the oil and gas industry have hitherto not been well understood or researched.

In relation to this, the research examines the current state of oil and gas construction projects in Saudi Arabia in order to examine the effectiveness of the current health and safety measures in place. The purpose of this research is to contribute to generating ideas through which the Saudi Arabian construction sector can be improved in terms of health and safety aspects.

Health and Safety issues are always combined in the literature and real life discussions making many think of them as one word relating to hazards on site. Even though they are two sides of the same coin, they mean different types of work-related hazards. In order to better distinguish between these two, this study breaks down the component into 'occupational health hazards' and 'hazards related to lack of safety'.

Occupational health hazards in the construction industry are related to the exposure of harmful substances in construction materials, repetitive works and exposure to consistent activities or power tools on work sites. The bottom line to this is the temporary or permanent degradation of worker health. The occupational health hazards in construction can be broken down into six categories namely: silica-related diseases, asbestos-related diseases, noise-induced hearing loss, musculoskeletal disorders (MSDs), hand-arm vibration syndrome (HAVS) and dermatitis (Safety Network, 2015). In brief, silica-related diseases are caused by Resirable Crystalline Silica (RCS) which are formed when construction materials containing silica such as concrete, tiles, granite and bricks are crushed, drilled, cut or abraded. Prolonged exposure to RCS causes difficulties in breathing and in the long term may, lead to lung cancer. Asbestos-related diseases are the biggest killers in the workplace. The danger arises when the asbestos fibre becomes airborne and remains suspended in the air. Similarly, exposure to noise may damage the ear in the long run. Also, repetitive work such as regular lifting, plastering and handling of materials and items, was proven to be one of the major causes of musculoskeletal disorders (MSDs). This disorder covers any injury or damage of the joints or other tissue in the back, upper or lower limbs. Another destructive occupational health hazard is hand-arm vibration syndrome (HAVS). This is usually caused by the prolonged use of hand-held power tools in construction work. The vibration caused by the power tools

permanently damage arms, hands and fingers over time. Dermatitis, on the other hand, is a health hazard in which the skin is inflamed as a result of exposure to hazardous substances such as wet solvents and cement. Two kinds: irritant dermatitis and allergic contact dermatitis.

The second side of the coin concerns the safety parts related to hazards caused by negligence in the implementation of safety measures. Therefore, the end results usually including falling from heights, trench collapse, scaffold collapse, electric shock and arc flash/arc blast and so on (United States Department of Labour, 2005). These safety issues are as devastating as the health-related hazards discussed above.

1.4.1 Health and Safety Related Needs in the Construction Sector of Saudi Arabia

According to Holt (2008), like some other heavy business industries such as the oil and gas industry, the need for effective health and safety consideration is vital in the context of the construction industry. It is due to this reason that large scale construction projects generally encounter a number of risks related to the health and safety of workers. The author has elaborated further that for the management of construction companies, there is a need for well-structured and effective policies ensuring the security of the health and safety of workers and employees.

Perezgonzalez (2005) has highlighted some of the major health and safety related risks and hazards faced within the construction projects and by organisations. In relation to this, the author has articulated that in a construction industry, various hazards including chemical hazards (including mists, vapour, dusts, fumes or gases, and silica particles), physical hazards (such as heat and cold, noise, vibration, radiation, and awkward

postures), biological hazards (i.e., histoplasmosis, soil fungus, influenza or tuberculosis) and social hazards (for example, mass layout due to unexpected intermittence of the construction project and the social impact of changes in the pay structure offered to the workers employed at construction sites), can be considered critical.

In addition to this, exploring some of the crucial difficulties associated with health and safety related aspects to the construction industry, Davies and Tomasin (1996) have stated that generally the overall span of a construction related project is quite comprehensive, and requires a number of different activities and involvement of personnel. In this way, the span of occupational risk and safety in the context of the construction industry increases to a significant level. However, the integration of the different governmental and regulatory frameworks of the country in ensuring the health and safety related aspects of workers with the project's operational processes can be considered as quite a complex task in the construction sector.

1.4.2 Measures for Addressing Needs in the Field of Health and Safety

Ferrett (2012) has also reflected that from the perspective of the construction industry, a significant amount of investment is required for undertaking different crucial projects. Owing to this reason, the amount of overall risk associated with the construction project is quite high. In this respect, the implication of any new policies and regulations related to the internal processes of the organisation can make these processes more complex and hard to manage. In this regard, the implication of the health and safety related aspects within the construction industry can prove to be quite critical within the construction industry. This is because for the purpose of deploying policies and regulations related to health and safety aspects, the management is required to make some intensive changes in

the existing operational and strategic operations. This change can enhance the level of risks involved within the construction projects.

In the context of Saudi Arabia, there are a number of different crucial laws and regulations related to the employment of different health and safety policies within the construction allied projects in the country's territory. Husein (2013) has articulated some of the legal and regulatory essentials employed by the legal authorities of the countries, which should be followed by Saudi construction industries and their related companies. As per the author, in the country, health insurance of every individual employed within any construction related project can be considered an essential activity for the employer of the project. In relation to this, there are a number of different legal arrangements such as The General Environmental Law (GEL) (2001), Implementing Regulations (IR) (2003) and the Environmental Protection Standards (EPS) (1982), which can be proven to be crucial in ensuring the effective delivery of health and safety related norms within the construction industry.

1.4.3 Regulatory Regimes Prevailing in the Saudi Arabian Construction Industry to Resolve Health and Safety Related Issues:

Hughes and Ferrett (2012) have also reflected that in the Saudi Arabian setting, any contractor who is directed to undertake any construction project is required to present an Environmental Impact Assessment (EIA) in front of the regulatory authorities of the country, and thus obtain permission from the regulatory authorities of the company. This permission can be retrieved in the form of environmental accreditation for the project. In gaining this permission from the government and regulatory authorities of the named country, the project contactor is required to demonstrate its health and safety related policies associated with the project. In this way, a structured supervision of policies and

practices of the construction industry of the country is maintained. This enables the regulatory authorities to employ a crucial and effective framework for ensuring the health and safety of every individual involved in the project.

In contrast to this, Perry (2003) has also projected that from the perspective of the construction industry of the country; the prime issue is related to the implication of different effective legal and regulatory norms in real life practices. Although, there are some intensive advantages of employing such crucial health and safety related laws and regulations, it is not easy for the construction allied firms to implement such crucial findings in their operations. It is due to this reason that there are some strict implications of such regulations. The proposition of such policies makes the execution of the construction project quite typical and lengthy. To be able to make the difference required in the execution of construction projects in the oil and gas industry, it is expected that regulatory requirements will take into account the specific issues related to construction projects in the sector and provide the necessary legislation that can have the required impacts.

1.5 Research Problem

The nature of construction activities and the associated health and safety issues, makes it necessary to take health and safety seriously when executing construction projects. In the oil and gas industry, health and safety remains a major concern for all activities. This makes undertaking construction projects in the oil and gas industry prone to higher levels of risks due to the nature of the facilities and the construction site or environment. Among all industry sectors, the construction industry requires considerations for health and safety measures at an increased level, as this is the most dangerous industry due to the involvement of risky activities at dangerous sites (Hughes and Ferrett, 2012). In the

construction industry, there is high degree of fatal accidents that require preventable measures on the part of the management. In the construction industry, the management of health and safety needs of the workforce has become an essentiality due to the growing number of construction projects. In construction projects, there is active involvement from people of different occupations such as architects, electricians, insulation workers, roofers, excavating and loading machine operators, hazardous waste workers and many others.

All these workers are generally exposed to a variety of health and safety related risks including noise, silica dust, awkward postures, cement dermatitis, heavy loads, and other chemical hazards, which can prove to be quite harmful in the long run for individuals. Owing to this reason, the organisational safety and health related aspects are essential for construction sites.

Consequently, the research question presented below becomes pertinent:

Research Question: What are the health and safety issues specific to construction projects in the oil and gas sector especially in Saudi Arabia and to what extent can the existing health and safety programmes undertaken within the oil and gas construction projects be considered viable and effective?

The presented research question is directed to investigate the effectiveness of the viability of health and safety related aspects. In addition to this, the answer to this research question will prove to be quite helpful for availing some in-depth and industry specific practices related to health and safety related aspects and developing an integrated solution that works for the industry taking into account the nature of the oil and gas sector.

1.6 Research Aim and Objectives

Based on the issues presented above, the aim of this research is to critically investigate the health and safety related issues in construction projects within the Saudi Arabian oil and gas sector and the adequacy of existing health and safety programmes to improve health and safety management in Saudi Arabian oil and gas construction projects. The presented research work will explore the different crucial health and safety related policies and regulations undertaken by different players operating in the Saudi oil and gas industry, so that effective and adequate evidence to answer the research question can be revealed.

In order to achieve this aim, the following objectives are expected to be pursued in the course of this research:

- Explore in-depth the existing research on health and safety management in the construction industry, so as to develop a theoretical understanding of the current situation of health and safety management.
- Critically review the existing literature on health and safety management in the Middle East construction industry, so as to bring together several factors influencing safety programmes that have been identified in previous studies.
- Investigate and document the factors influencing safety programmes that are particular to oil and gas construction projects in Saudi Arabia.
- Integrate factors influencing safety programmes and to critically assess their impact on Saudi Arabian oil and gas construction projects.

- Develop a framework that can help construction health and safety managers to focus their priorities on factors that will significantly reduce accidents on construction project sites.
- Test and demonstrate the applicability of the developed framework.

The findings of the entire research will be focused on achieving these objectives.

1.7 Research Methodology

Research methodology is used to gather the required amount of data and information from different sources that need to be considered in accordance with the requirements of the research study. Methodologies have been chosen in such a manner that they are sufficient to fulfil the core requirements of the research question, aim and objectives of the study. Furthermore, Abdulai (2007) and Bashir (2013) recommended that the choice of a particular research method should consider the nature of the research problem, the research question, the aim and objectives, the availability of resources, and the personal experience of the researcher. In line with these recommendations, the pragmatic philosophical stance that involves a combination of both quantitative and qualitative method (i.e. mixed method) was chosen for the study. The rationale for the choice of this method is that the researcher is able to look at the research through both an objective and subjective point of view while at the same time combining the strength of both methods to complement the weakness of the other. According to Grix (2010), the use of both methods improves the quality of the research study, moreover it also promotes a greater understanding of the findings in the research study (Axinn and Pearce, 2006). For the qualitative method, a semi-structured interview was used to gather data necessary for the development of a model for health and safety management in Saudi Arabian oil and gas construction project. The population targeted were purposively sampled to include nine

professionals working in the oil and gas construction sector. Each one of them is knowledgeable and familiar with health and safety on construction sites.

The data collected entailed descriptions, explanations, narratives of experience, feelings and opinions of professionals on how to ameliorate health and safety. The data obtained were coded and analysed using thematic analysis. As for the quantitative method, a structured questionnaire was used with a series of close-ended questions to determine various factors such as the impact of health and safety policies, awareness of health and safety policies and the effectiveness of health and safety policies and practices among others. A total of 300 questionnaires were distributed to collect the aforementioned data. However, only 200 were ultimately collected as valid responses. The collected data were analysed using descriptive statistical tools such as frequency distribution and inferential statistics, in particular, the one sample chi-square test. To allocate priorities and report the results accordingly, the ranking indices were used based on the frequency distribution results. In addition, the interpretation that emerged from the frequency distribution, was compared to the outcome of the result and determines how the company influences health and safety policies and practices in the organisations. The comparison was done using cross tabulations approach. All these processes were made possible through the Statistical Package for the Social Sciences software (SPSS). Finally, a proposed framework was developed using the findings from the reviewed literature, and the outcome from the qualitative and quantitative methodology.

1.8 Scope and Limitation of the Study

The scope of this study was confined to health and safety in the Saudi Arabian oil and gas construction industry. This means that all other sectors that involve construction and engineering practices were not directly considered. Nevertheless, health and safety issues in the oil and gas construction industry are still similar to health and safety in other sectors that involve construction related activities, thus, the outcome can be generalised.

A number of limitations likely to affect the representativeness of the issues surrounding the industry and the application of the health and safety model are proposed. The main limitations are related to data collection. Even though the data collected focuses on both qualitative and quantitative data sources, the spread of interviewees for the qualitative data presents a limitation to the research. To ensure a wider coverage of the issues in the sector, data collection needs to include more participants from all over the country. This would ensure that the views presented represent the industry in its entirety. Another limitation of this research is the lack of data collection covering government agencies and personnel who are legally required to control health and safety issues. Including such people in the data collection would have helped to increase the coverage and improved the results of this data. Notwithstanding, the outcome of the research can represent the industry as much as it can make the results applicable.

1.9 Contribution to Knowledge

This research contributes to knowledge by providing evidence on the current state of health and management within the construction industry. The results from the research also informs researchers, professionals and stakeholders in the Saudi Arabian construction industry on the various practices regarding health and safety and the need to

improve those practices towards developing proper health and safety management policies and creating a safety culture.

For companies within the Saudi Arabian construction industry, this research contributes to improving health and safety within such companies by developing a best practice framework. The framework takes into account best practices from other industries and develops an approach directed at the specific nature of the construction industry and the Saudi oil and gas sector. This contribution is expected to help the industry by suggesting the need for corporate level approaches that can help to create a safety culture within the construction industry and ultimately translate into project level practices. The framework developed also contributes to the industry by suggesting the need for performance measurement in terms of health and safety and using this measurement as a means for capturing knowledge for subsequent projects. Finally, the framework developed by this research also provides a basis for further research into better approaches to improve the current level of performance.

1.10 Dissemination of the Findings

The results from the research have been disseminated through journal paper publications, conferences and poster presentations. The article was published in the International Journal of Social Science and Human Behaviour Study. The conference was held in the Third International Conference organised by the Institute of Research Engineers and Doctors in Rome, Italy.

1.11 Structure of the Thesis

This thesis consists of eight chapters, which are discussed accordingly as follows:

Chapter One commences with a brief introduction of the research, the research background, and the research context that involves brief discussions on the measures for addressing health and safety together with the introduction of the regulatory regimes that prevailed in resolving Saudi Arabian construction health and safety related issues. The chapter then outlines the research problems, and the research question, as well as the research aim and objectives. Subsequently, the research methodology adopted was briefly discussed together with a justification for the adoption. Lastly the scope and limitations, contribution to knowledge and the way the research was disseminated was highlighted.

Chapter Two sets-out the scene for the review of literature on health and safety management in the construction industry. Naturally, an overview of the Saudi construction industry was presented together with the discussion on the health and safety management practices in the Middle East construction industry. Furthermore, a review of the existing safety programs in the Saudi Arabian oil and gas construction industry was undertaken to determine the current state of measures employed in Saudi and their effectiveness in preventing potential safety health and safety hazards. In conclusion, the factors that affect the implementation of health and safety measures on Saudi oil and gas construction sites were reviewed and evaluated against those of other countries.

Chapter Three presents the conceptual framework which improves health and safety in the Saudi Arabian oil and gas construction sector. It explains how significant external and internal sources of safety knowledge are important in developing a functioning health and safety management system. Factors such as improving safety behaviour and practices, improving safety culture, and proper communication among employees were shown to promote an effective safety management system. Finally the chapter establishes that various practices mentioned in the conceptual framework would support the development

of better safety management systems that can be implemented in the oil and construction industry to minimise the number of accidents.

Chapter Four introduces the various research methods employed in social science research to achieve a desirable research outcome. These research methods were evaluated against certain criteria of this study in order to settle for the most appropriate one to adopt. The chapter further explains and provides justification on the selected research method employed. The chapter then explains the data collection method employed, the instruments used for the data collection, and the appropriate sampling technique chosen. The chapter also explains the various forms of data analysis method used to analyse the data obtained from the respondents. Finally, the chapter described how the ethical approval was obtained for the study.

Chapter Five presented the qualitative analysis and discussions of the results. The chapter first presented the interviews of the organisation's profile, the size of the organisation and status, the interviewee's position in the organisational structure and their years of work experience. Furthermore, it illustrated the results and discussions on the importance and benefits of applying functioning health and safety measures, the roles of interviewee's organisation in preventing negative exposure to health and safety risks, the effectiveness of health and safety measures applied in the interviewee's organisation and finally the health and safety measures necessary to prevent the prevalence of accidents.

Chapter Six presents the findings and discussions on the quantitative study. It begins by showing the demographic analysis of data, the distribution of the survey's respondents while looking at the number of respondents and size and the type of companies, years of experience and position of respondents within their companies. Other factors presented in the chapter are the results and discussions on the impact of health and safety policies

on Saudi oil and gas construction industry, the importance of health and safety management to the company processes, the measures towards improving health and safety on oil and gas construction projects, the approach to health and safety management and education and lastly barriers to achieving health and safety. In the last section, inferential statistical tools such as cross tabulations and correlations were used. Spearman's correlation was deemed appropriate in finding the relationships between the different variables of the data.

Chapter Seven presents the procedures and outcomes of the study in the form of an integrated framework. It discusses the various parts of the framework and also illustrates how the framework could be implemented to improve the health and safety performance in construction projects within the oil and gas sector in Saudi Arabia.

Chapter Eight presents the validation of the research findings and the evaluation of the relevance of the framework developed to improve the health and safety performance on construction projects within the oil and gas sector in Saudi Arabia. It begins with discussing the various types of validation method employed in the literature and then selects the most appropriate and convenient approaches for the study. The chapter conclusively presents the outcome of the entire research to be valid.

Chapter Nine presents a summary of the findings for the entire research, and drew conclusions on them while also giving recommendations to professionals and policy makers in the Saudi government. Conclusively, an area for further research is clearly stated in the chapter.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction to Chapter Two

The construction industry is a vital sector of the economy in most countries and viewed as the engine for growth of the economy particularly in third world countries. The sector typically contributes to approximately more than 11% of gross domestic products (GDP) in third world countries (Yiu et al., 2004). The activities associated with construction are linked to inherent safety and health perils the activities include working underground, working at a height, working in confined spaces or near falling objects, handling hazardous substances, noises, manual handling of loads, dusts, using plant equipment, ergonomics, poor housekeeping, and exposure to naked live cables (Tam et al., 2004). With the advancing complexities of Broad-domain projects to adopt and modernise urban-centres and with an increasing demand for offices, housing and other infrastructures and services as a result of rapid urbanization, construction activities have remained predominantly high leading to a relatively higher safety and health risks in the urban context(Alhassan,2013). Though the sector is important to the growth of the economy, it is linked with frequent and higher rates of accidents amongst practitioners, end users and workers. The construction industry has been known for long time as a dangerous industry due to a larger number of accidents and deaths that take place in and on construction sites globally.

Construction managers therefore believe that the introduction and execution of measures to curb such accidents and fatalities so as to guarantee health and safety in construction can make the industry incur extra costs and reduce profit return. Safety and health management construction thus has concerns in construction managers' actions to

establish a system in an organisation in which workers are well trained to execute safe activities in construction industries (Langford et al., 2000). This study will thus assist in exploring the alternatives to investigate to what extent which partnership among construction managers, construction workers and health sectors will have an impact on the health and safety of participants in construction industries within Saudi Arabia. This section presents and explores, from existing literature, the nature of the construction industry in Saudi Arabia with an emphasis on oil and gas construction projects to determine the risk inherent in working in the industry. The chapter also reviews the health and safety management systems and standards adopted in the industry as well as the legal system in place for managing health and safety issues. The chapter also reviews the sources of risks and the legal aspects of health and safety in the construction industry. The chapter also reviews the sources of health and safety risks and the current measures adopted to manage the issues.

2.2 Overview of the Saudi Arabian Construction Industry

The Kingdom of Saudi Arabia (KSA) is the largest country in the Arabian Peninsula and is one of the largest producers of oil and petroleum products, with 21% of the total world oil reserves. The global economic crisis had an adverse impact on the economic growth of the kingdom, as Saudi Arabia was one of the countries of the Gulf Cooperation Council (GCC) that showed unhampered economic growth and emerged completely unscathed from the global financial scenario (Saudi Construction Industry 2010). Saudi Arabia has the largest construction industry in the Middle East region. Despite the global meltdown, the country has managed to endure the crisis because of its strategic and diversification programme, and sustainable infrastructural investments (Federal Research Division, 2004).

The government in the Kingdom of Saudi Arabia has made various efforts to encourage and promote sustainable construction programmes such as the Leadership in Energy and Environmental Design (LEED) training programme and awareness programme, which have led to the development of the construction industry for Saudi Arabia at a global level. The country's oil and gas sector is dominated by the government owned company, Saudi Aramco, which is the world's largest oil company for the production of hydrocarbons (U.S. Energy Information Administration, 2013).

The country has been investing extensively in its infrastructural projects and other sectors related to the construction industry, as shown below in figure 2.1, around 67% of the nation's construction investment is contributed to by Saudi Aramco. The major sectors that involve significant investments include infrastructure, the oil and gas sector, pipelines, industrial construction, power and water, and buildings (Saudi Construction Industry, 2010).

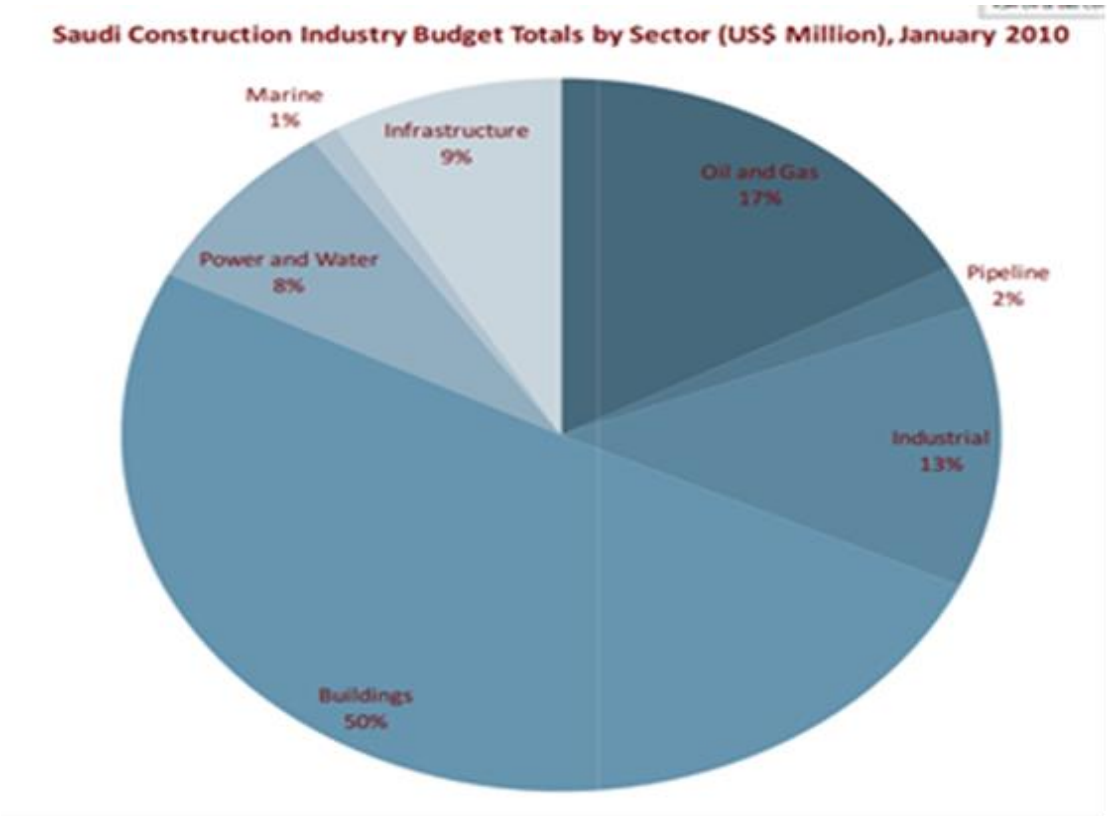

Figure 2.1: Saudi Construction Industry Budget Totals by Sector (Source: Saudi Construction Industry 2010)

As can be seen from the background of the Saudi Arabian construction industry presented in Figure 2, there are high levels of investment in the industry with emphasis on developing the country as a whole. The rate of development, coupled with the nature of construction projects being undertaken, makes the need for improved management of the projects very critical.

2.2.1 Oil and Gas Construction Projects in Saudi Arabia

To provide a focused review of the issues related to the chosen research area, this section provides information on the nature and volume of construction projects undertaken in the

oil and gas sector in Saudi Arabia. In this regard, it can be seen that the oil and gas sector in Saudi Arabia is a major contributor to the high volumes of construction projects in the Kingdom. As a country with large deposits of oil and an emerging economy, the oil and gas sector in Saudi Arabia embarks on many construction projects. Research by Albassam, (2015)suggests that the oil and gas sector remains the driving force in the Kingdom of Saudi Arabia. For the purposes of this research, oil and gas construction projects relate to projects that are undertaken for the purposes of oil and gas exploration activities. Construction activities within the oil and gas sector cover main projects such as: offshore construction activities including the construction of oil platforms and production lines, offshore oil fields, gas pipelines, oil refineries, drilling facilities and accommodation for the purposes of oil and gas explorations. Taylor and Carson (2014) report that the construction of large onshore oil and gas processing plants bring large economic contributions. Ruqaishi and Bashir (2015) report that oil and gas construction projects in the gulf region have many challenges including delays. Research by Chen (2011) suggest working in oil and gas construction projects is both challenging and hazardous due to the remote and hostile work environment and the demanding shift work schedules, which often necessitate daily adaptation. Berends (2007) presents results which suggest that large engineering and construction projects such as those involved with oil and gas operations are technically complex involving the integration of many different technical disciplines on the basis of a large codified body of knowledge.

2.3 Health and Safety Issues in the Construction Industry

The construction industry is full of complexities due to constant challenges in working conditions and the demanding nature of the work involved. In the construction industry, all job responsibilities have an impact on safety and risk factors that affect the overall

safety management system of construction companies. The literature on health and safety in the construction industry indicates that many issues are responsible for the health and safety issues in the industry. The factors recorded in the literature include: adverse working conditions and culture, external environment factors, equipment failure, high costs, workers' attitudes and behaviour, management factors, and knowledge management aspects. All these factors affect the working process of the construction industry in different ways.

In construction organisations, when working conditions are worse and the culture is not supportive for workers, the result is weak performance by the organisation. When site conditions are not conducive for work in terms of layout and working space for employees, workers have a negative perception of the organisation. The working environment on construction sites have high noise levels and poor lighting conditions that affect the physical and mental health of workers, and thus their efficiency level is affected to a great extent (Departments of Human Sciences and Civil and Building Engineering and Manchester Centre for Civil and Construction Engineering, 2003). Work schedules and the availability of equipment are also crucial factors regarding the health of workers in organisations.

The external environment of the construction industry also affects the overall performance of workers and organisations. In the external environment, climatic conditions and natural disasters are also critical factors in maintaining safety measures at work sites. Besides these, serious chemical hazards and vigorous natural conditions result in a high degree of threat to construction companies (Cahill, 2013). The external environmental conditions are beyond human control and their probability of occurrence

is also uncertain. Therefore, their impact on health and safety on construction sites is very high.

Other critical factors that affect health and safety aspects in the construction industry include equipment failure. In business processes followed in the construction industry, there is a high dependency on equipment, and when such equipment is not in a safe working condition, workers are under constant threat of accidents. This affects not only their performance level but also their mental health (Al Haadir and Panuwatwanich, 2011). Equipment failure also results in delayed work processes, which ultimately hampers an organisation's performance.

In the construction industry, high costs are also a major factor that affects health and safety in organisations. The high frequency of accidents and hazards at construction sites means that construction companies incur high costs in dealing with critical problems (Dvir, 2005). This financial burden deters the management from taking effective measures to install new safety systems, and thus the problem of health and safety remains critical in organisations.

Another factor is workers' attitudes: when their attitude and behaviour are not positive, they show a kind of ignorance for work duties, and their negligent behaviour and unsafe actions sometimes result in serious accidents (Jannadi and Assaf, 1998). As construction projects are very sensitive in nature, there is a high probability of risks and threats in terms of health and safety concerns. Due to this problem, the positive work behaviour and attitude of workers is essential in the construction industry in order to keep the workplace safe from unwanted accidents and safety problems.

In relation to the factors that affect health and safety aspects in construction organisations, management factors are also critical in keeping the workplace safe and ensuring

organisational performance is at a good level. When management strategies towards safety aspects in construction organisations are not supportive in dealing with issues of accidents and hazards, the result is an unsafe work environment for employees and workers (Alasamri, Chrisp and Bowles, 2012). The optimisation of effective management approaches is required in order to have effective human interaction in organisations, to ensure they take corrective actions to deal with health and safety related problems faced by them in organisations.

The other factor that affects health and safety aspects in the construction industry is a lack of knowledge management practices, and their follow-up in construction organisations. Ineffective knowledge transfer in the construction industry results in several safety related problems in these organisations, and as a result, the management in organisations become incapable of developing new training and safety programmes for employees.

All these factors are critical in nature and their involvement in the construction business process affects health and safety aspects to a critical level. Theoretical aspects as illustrated by different authors, are presented in Table 2.1 below:

Table 2.1: Theoretical aspects of Health and Safety as illustrated by different authors

Names of Scientists/ Authors /Year	**Adverse Working Conditions and culture**	**External Environment**	**Equipment Failure**	**High Costs**	**Behaviour and attitudes of workers and employees**	**Management factor**	**Knowledge management**
Ismail, Samad Doostdar and Zakaria Harun (2012)	✓	✓	✓		✓	✓	
S. Al Haadir and K. Panuwatwanich (2011)	✓		✓		✓		
Osama Jannadi and Sadi Assaf (n.d.)	✓		✓		✓	✓	
David Oloke, Hao Yu and David Heesom (2007)							✓
Dov Dvir (2005)			✓		✓	✓	
Khalid Al Saleh and Mohamed Ramadan (2011)	✓		✓		✓		
Lawrence B. Cahill (2013)		✓					
Dr. M.O. Agwu (2012)	✓		✓	✓	✓		
Hasan Alasamri, Malcolm T. Chrisp and Graeme Bowles (2012)	✓		✓		✓		
Ploypailin Pungvongsanuraks and Thanwadee Chinda (2010)						✓	
Matthew R. Hallowell (2012)							✓
Departments of Human Sciences and Civil and Building Engineering and Manchester Centre for Civil and Construction Engineering (2003)	✓		✓	✓			
Charlotte Brace, Alistair Gibb, Martyn Pendlebury and Philip Bust (2009)	✓	✓	✓	✓			
Gouranga Banik (n.d.)		✓	✓				
Total	**8**	**4**	**10**	**3**	**7**	**4**	**2**

2.4 Health and Safety Management in the Construction Industry

2.4.1 Health and Safety Management Systems

The management of safety requires a corporate wide approach and decisions need to be made and managed from an organisational perspective. As reported in Lee and Guldenmund (2018), managing safety takes comprehensive efforts and needs an organisation to determine safety requirements Strutt et al., (2006), designed a safety management structure and process, and decided which activities needed to be implemented in order to achieve pre-defined safety requirements. Swuste et al (2011) suggest that the history of safety management systems (SMSs) coincides with the history of accident prevention and safety science as they sought to achieve the same goals.

Many scholars have suggested that the use of health and safety management systems (H&SMS), play a role in ensuring the management of health and safety. Robson et al (2007) report that different health and safety management systems have been produced to help with the management of health and safety issues. Niu et al (2019) also suggest that research efforts towards occupational health and safety management in the construction industry have been undergoing different developmental stages. The history of this development has covered the adoption of hard measures such as the use of personal protective equipment to be used as a buffer between the dangers in the industry and the personnel working in the industry (Niu *et el.,* 2019; Iinze et al., 2013). Although the adoption of personal protective equipment (PPE) was known to provide to a large extent protection from health and safety hazards in the industry, researchers such as Holt (2008), report that one of the fundamental limitations of the use of PPE for the purposes of preventing accidents is that it does not eliminate the hazards in the industry. Due to the

limitations of the use of PPE for health and safety purposes in the industry, several systems have been adopted with the view to eliminate hazards in the industry.

The development of health and safety systems in the industry have concentrated on identifying the root causes of accidents within the industry and adopting measures to help prevent such causes from occurring. This suggests that systems should be put in place not just to protect workers from dangers and health incidents but should be adopted as a means to remove the sources of such dangers.

Health and safety management systems are defined as "decision making, recognizing that the rationality of human decision-makers (e.g. safety managers and construction workers) is generally bounded by a triangle of limits" (Simon, 1976): available information, cognitive ability, and finite amount of time. This definition suggests that the systems put in place for the management of safety should be based on information and ability and ability, and there should be enough time invested in the process.

Other definitions in the literature suggest that health and safety management systems indicate that there is lack of consensus as to what a health and safety management system is. These differences notwithstanding, there is a general suggestion that health and safety management systems help to ensure a pragmatic approach to managing health and safety in organisations. Kysor (1973) for example, defines safety management systems as a planned, documented safety program that incorporates certain basic management concepts and activating elements into a well-organized safety system. Similar views are presented in Yorio et al (2015) who suggests that an H&SMS can be broadly characterised as a set of institutionalised interrelated and interacting strategic elements designed to establish and achieve occupational health and safety goals and objectives. Yorio et al (2015) report that health and safety management systems cover a set of commonly

purposed and complementary health and safety management practices, policies, and procedures.

Although there are many studies focussing on occupational health and safety management systems, Robson et al (2007) suggest that health and safety management systems go beyond occupational health and safety management systems (OHSMSs). In their research it is reported that the concept of a safety management system overlaps with that of an occupational health and safety management system, but the distinction is the extension beyond workers to include the physical work environment and the surrounding community. A review of the literature suggests that developing health and safety management systems in the industry has undergone many changes over the years. The development saw the use of system safety techniques during the 1970s and 1990s to analyse, identify and display potential hazards (Lee and Guldenmund, 2018). Kegg (1998) reports that in line with the development of H&SM systems, efforts have been made by management in different industries. For example in the mid-1970s, Australia put efforts into developing (Environment Health and Safety) management (EH&S) and initiatives, such as 'contractor management, quarantine procedures, incident and injury reporting and investigation, etc. (Kegg, 1998, p. 441).

Lee and Guldenmund (2018) suggest that a safety management system is specifically designed to control and manage safety. Different definitions have been given for safety management systems in different contexts. Dezfuli et al (2011) suggest that irrespective of the context, the overall scope of safety can be divided into human, environmental and equipment safety.

2.4.2 Components of a Health and Safety Management System

From the literature, it can be established that a health and safety management system covers three main areas: human, environmental and equipment safety. The review of the literature suggests that different elements come into play to ensure such systems work to the benefit of the company. Research by Yorio et al (2015) suggest that through the use of enacted policies, practices, and procedures contained within the health and safety management systems (HSMS implementation) at the workgroup and worker level, the benefits of decreased injuries, illnesses, and health and safety incidents are expected to be achieved.

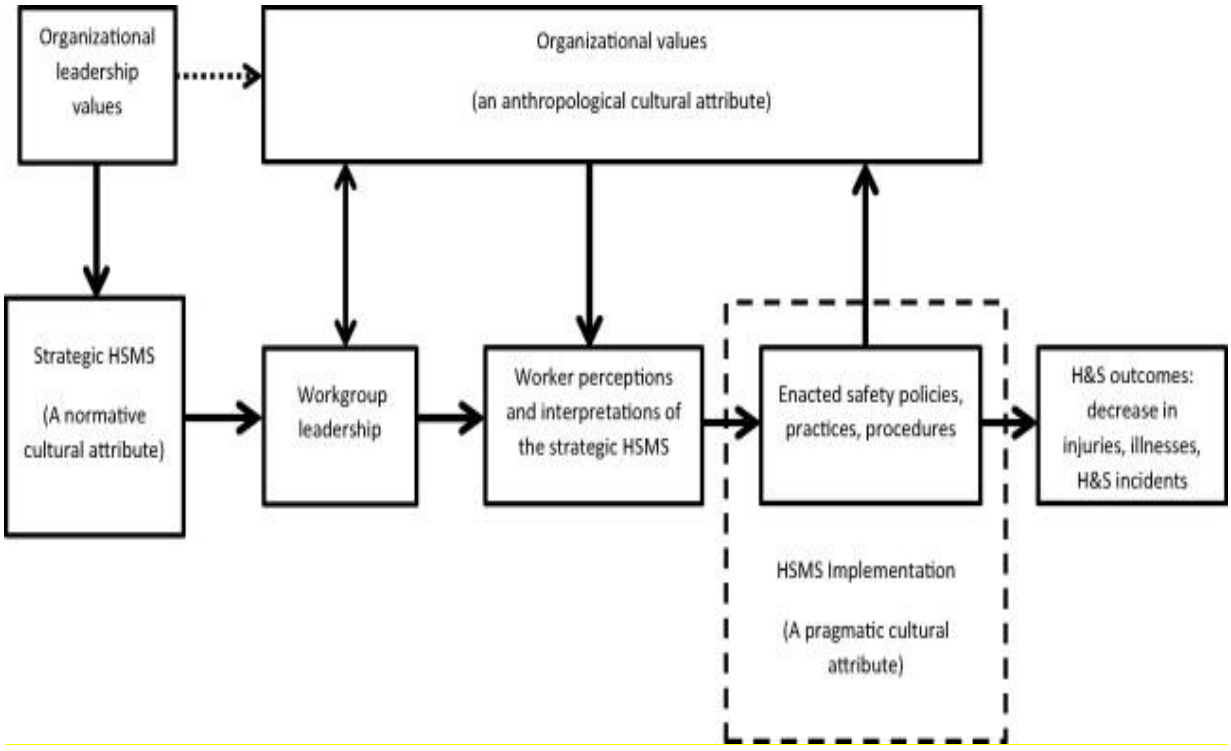

Figure 2.2: Conceptual framework for implementing health and safety management systems (Yorio et al., 2015)

The framework suggests that to ensure that HSMS works correctly, there is the need for leadership to be involved in the process by setting the values for health and safety, and ensuring the values are driven down to the workers of the company, and putting in place measures or policies for its management. There should also be a system in place to enact policies towards health and safety and to ensure such policies lead to the desired outcomes by monitoring and measuring performance.

To be successful, HSMS put in place by companies should be able to cover human safety, environment safety and equipment safety. The system according to Wachter (2014) should be developed taking into consideration all aspects of the business of the company. Wachter and Yorio (2014) also report that, the development of health and safety management systems should consider the human performance approach which attempts to understand and eliminate the causes of human error (and thus accidents or events) in the workplace from both safety management and behavioural systems perspectives. The human performance approach to health and safety management is viewed as a very important aspect of safety management. As presented in Watcher and Yorio (2014), it is recognised that mission, goals, policies, processes and programmes (safety management system components) have latent organisational weaknesses that could give rise to flawed defences and error precursors within organisations (Reason, 1997 in Watcher and Yorio, 2014). Parez et al (2019) suggest that the setup of a safety management system provides support for setting (safety) performance goals, organising, planning and implementing risk mitigation activities, assessing (safety) performance, and taking action for further improvement.

For the purpose of managing health and safety in the construction industry, safety management systems should be able to provide the needed framework to support the

design and management of practices towards accident prevention and ensuring accidents caused from the use of equipment used for delivery of construction projects are prevented.

Adopting such systems would ensure the construction companies have an overarching strategy and system in place for managing and dealing with health and safety related issues.

2.4.3 Health and Safety Standards

For the management of health and safety in the construction industry, different standards have been developed to measure and manage the level of safety to be achieved by organisations. These standards are designed as management tools to measure and evaluate occupational risks and ensure that safety management systems live up to their expectations. Bodies such as the International Standards Organisation (ISO), International Labour Organisation (ILO) and Health and Safety Executive (HSE) publish health and safety standards that must be met by all organisations. Sui et al (2018) reports that health and safety standards have been adopted in different industries to improve the performance of safety. Research by scholars such as Su et al (2015); Govindan et al., (2015) and Fernández-Muñiz et al. (2012) also related to the recent statement as mentioned above. Standard such as ISO14001 has been used by different companies to implement environmental management systems as a management tool to control and reduce their environmental impacts. In addition to the ISO14001 standard adopted by construction companies, different safety management standards are adopted by organisations in other industries.

2.4.4 Health and Safety Legislation

Research by Ncube and Kanda (2018) report that the International Labour Organization (ILO) Convention No. 161 of 1985 and the World Health Organisation (WHO)'s 2008e2017 Global Plan for Action both demonstrate the value that the international community has for safety issues. The realisation that safety issues exist forms the basis for enacting health and safety legislation across various industries with the view of controlling and managing the approaches taken by organisations to manage health and safety. Loosemore and Maloufe (2019) report that despite many decades of policy reform, safety research and safety initiatives, the construction industry remains notoriously dangerous in many parts of the world. The notoriety of the industry coupled with high levels of accidents and incidents have led to increased regulation in the activities of construction companies.

From research efforts around the world, it is reported that the use of health and safety legislation has a big role to play in ensuring the success of any system. The review of literature suggests that legislation on the management of health and safety began to increase in the 1970s and 1980s due to the increased demand for international standards (Hale et al., 1997). Governmental bodies such as the Occupational Safety and Health Administration (OSHA) in the US, the Health and Safety Executive (HSE) in the UK, and the World Safety Organisation (WSO) are key bodies that made an impact worldwide. The increase in the amount of safety management legislation helped to increase the awareness of health and safety across many industries. In countries such as the UK, different legislation has been enacted to ensure safety practices and standards are adhered to throughout the different industries. Safety legislation in the UK, for instance, covers areas such as: health and safety at work, safety of people on construction sites, safe use

of materials, and equipment, among others. The work of the researchers in this field of study notwithstanding, it is reported that despite many decades of policy reform, safety research and safety initiatives, the construction industry remains notoriously dangerous in many parts of the world.

In places such as the UK, Australia, Hong Kong and in America, H&S legislation has been developed to improve the safety practices in the industry. Ganah and John (2015) for example suggest that health and safety planning and management in construction can be summarised in five main areas (1) safety legislation, regulation, standards and guidelines; (2) appointment of construction and design management (CDM) coordinator by the client; (3) designers' H&S considerations upstream in the creation of the artefacts and its associated hazards and risks consequences. (4) management of these H&S risks during construction for site personnel, in particular writing-up method statements for work activities; and (5) development of an H&S plan and the creation and development of the H&S file through the life cycle of the project (Ganah and John, 2015 p 41). These areas suggest that legislation and the use of standards form a critical part of the approach to managing health and safety (Manu et al., 2013). Current legislation such as the CDM regulations 2015 in the UK have synthesised the health and safety management process by ensuring responsibilities are adhered to. Manu et al (2013) report that legislation has the most environmental influence on the construction industry.

The review of literature on health and safety legislation also suggests that legislation alone does not and cannot solve all the problems in the industry. In the Middle East, Awwad et al (2016) report that although there is legislation on health and safety, there is generally a lack of specificity and enforcement of such legislation by the governments in the region leading to poor performance of such legislation.

2.5 Health and Safety Management in the Middle East Construction Sector

This section provides a general overview of the approach taken to manage health and safety within the construction industries of Middle Eastern countries. This is followed by a review of literature on health and safety management within the construction industry of Saudi Arabia. The essence of the review is to compare the practices in the Middle East and more importantly Saudi Arabia, to determine the extent to which health and safety practices meet that of the developed countries internationally.

According to Kenrick (2012), the construction industry in the Middle East has witnessed tremendous growth and fundamental changes over the past few years due to the increase in globalisation, liberalisation and internationalism. However, although the industry has been growing fast and is considered to be one of the major sources of employment, and income and growth, the health and safety standards do not ensure the safety of the workers in these sectors. Kenrick adds that in the last few years, the Middle East has been taking the issue of the health and safety of construction workers more seriously and has taken various measures in this regard (2012). The author explains that work-related injuries have been increasing in the region and according to studies on this, most of the injuries occurred due to lack of personal protective equipment (Kenrick 2012).

As stated by Jannadi and Assaf (1998), in the Middle East there is no statutory body that oversees the health and safety of workers or ensures that PPE items are properly used. Officially, the Ministry of Labour is the authority that should enforce proper health and safety laws (Jannadi and Assaf 1998). There are various laws for the health and safety of labours, such as the Labour Law that oversees the employee rights and provides guidelines for proper use of PPE, first aid and medical facilities (Kenrick 2012). Research

from various authors suggests that the current state of affairs is not comparable to that of the international community.

2.6 Health and Safety Management in the Saudi Arabian Construction Industry

As presented in the introductory section, the construction industry in Saudi Arabia has experienced unprecedented growth over the last two decades and the country's infrastructure has witnessed rapid expansion. Yet, in spite of this rapid growth, the health and safety management in the sector has not yet reached the required standard, as there are not specific rules or policies for maintaining health and safety. The construction industry accounts for 15% of the Saudi Arabian labour force and therefore, their health and safety must be the primary concern for authorities.

Jannadi and Bu-Khamsin (2002) state that despite the enormous growth and development in the construction industry, it has always been under scrutiny with respect to the issues arising from the safety of the construction workers. The authors add that regulatory agencies, owners and contractors need to provide a safe working environment to workers in order to minimise injuries (Jannadi and Bu-Khamsin 2002).

According to Alasamri, Chrisp and Bowles (2012), the total number of injuries that occurred between 2004 and 2010 was 261,076 and deaths were 2,176. It was found that 95% of these accidents were due to the inadequate safety measures taken by the construction industries (Alasamri, Chrisp and Bowles 2012). Thus, although the construction sector in the country has been growing at a fast pace, it lags far behind in the context of safety measures that must be adopted at construction sites. The safety management system refers to the organisational operations that are conducted with regard

to the safety of employees, and involves the planning, implementing, monitoring and reviewing of safety measures and their performance. However, an effective safety management system requires proper leadership, alignment with rules and regulations, strong commitment and involvement of the management in the safety of the workers (Alasamri, Chrisp, and Bowles 2012).

Jannadi and Bu-Khamsin (2002) argue that in the construction industry, the sites are constantly changing, which leads to changes in the work environment and time spent at one particular site may be comparatively short. Therefore, the authorities are not able to understand and deal with the inherent risks effectively. Even if they do effectively understand and implement risk avoiding measures, the risks alter, to the changes in the site and therefore, those measures become hazardous. Therefore, it is quite difficult to deal with risks completely. Also, the turnover rate of the construction workforce is quite high and therefore, sometimes the new workforce might not be aware of the safety measures that have to be adopted or the risks that might occur at the construction sites (Jannadi and Bu-Khamsin 2002).

Kenrick, Allen and York (2011), state that one of the major issues related to injuries on job sites is the unfavourable climatic conditions together with the inappropriate use of PPE. In fact, due to high temperature levels, the UAE Ministry of Labour banned midday site work from mid-June to mid-September, due to the unfavourable working conditions during that time. This was an initiative regarding the health and safety of workers and it was followed by Saudi Arabia (Kenrick, Allen and York 2011).

Jannadi and Assaf (1998) further explain that the implementation of a proper safety management system in a construction project is the responsibility of all parties that are involved in the project, such as the owner, architect, engineers and contractor. The safety

management must be well implemented from the initiation of the programme; in other words, the owner must ensure that architects and engineers develop a feasible design and the site that has been chosen must be one involving the least risk. Contractors must adopt proper measures for the safety of workers and proper training must be given to workers in order to avoid any uncontrollable circumstances (Jannadi and Assaf 1998).

2.6.1 Health and Safety Policies and Legislation in the Saudi Arabian Construction Industry

The Kingdom of Saudi Arabia has enacted several laws regarding health and safety in the construction industry with an emphasis on the safety of workers. Like many countries, there are different policies and legislation developed by the government to ensure health and safety is achieved. Key legislation relating to health and safety include: Royal Decree No. 21 (6/9/1389 H) on Safety in the Workplace (1969); Regulations and Procedures for Hazardous Waste Control (Document No. 01-2002);

The country has also issued a list of certain hazards that have resulted from onsite accidents. In addition, Saudi Arabia has adopted all precautions that are required for the protection of workers and to increase the production and enhance the industrial and economic development. A number of government bodies are involved in the protection of workers in construction and other industries from occupational hazards. These government bodies include Ministry of Labour, the General Organisation for Social Insurance (GOSI), the Ministry of Health, the High Commission for Industrial Security, the Royal Commission for Jubail and Yanbu, and the General Directorate of Civil Defence. (Occupational Health and Safety in the Kingdom of Saudi Arabia).

The Ministry of Labour is generally involved with the inspection of sites and spreading awareness among workers about the occupational health and safety programmes. The General Organization for Social Insurance (GOSI) treats and compensates for injuries and participates in the preparation of new laws, rules and regulations for health and safety in Saudi Arabia. It also recruits and trains skilled medical professionals and engineering staff involved in the construction industry, in order to enhance occupational health and safety, and to conduct field studies for checking chemicals and equipment used at work. The Ministry of Health is concerned with the implementation of programmes for occupational health and safety. These programmes include radiation protection, medical waste and infection control at work sites. The Ministry of Health collaborates with the General Organization for Social Insurance (GOSI) and Ministry of Labour in order to develop and follow up the safety programmes. They, as a combined entity, prepare laws and regulations to be implemented in Saudi Arabia and also provide health care and first-aid services to the injured workers. They also invite experts from the World Health Organisation (WHO) to develop more effective occupational health and safety programmes.

The other programmes include the Saudi Aramco Programme of Occupational Health and Safety, which involves the occupational medicine division and occupational medicine team (Occupational Health and Safety in the Kingdom of Saudi Arabia n.d.). Aksorn and Hadikusumo (2008) report that the Saudi occupational health systems have developed over last decades by focusing on health interventions to ensure that workers have suitable work-related health support, helping them adapt the psychological and physical demands which work-places put on them especially as they get older. Therefore, all these programmes have been developed for protecting workers from work site injuries, but their

successful implementation depends upon a number of factors which include: working conditions, investment in health and safety by the construction companies, the safety culture in the construction industry and attitudes of workers towards safety.

Research by Alhaadira and Panuwatwanich (2011) however suggests that health and safety legislation in the Saudi Arabian construction industry lacks proper implementation.

2.7 Factors Affecting Health and Safety Management in the Saudi Arabian Construction Industry

There are different factors that affect health and safety aspects in the construction industry on different levels. These factors mainly affect workers, performance, and the organisation, overall. The major factors that have a significant impact on health and safety in terms of performance, workers and organisations are equipment failure, working conditions and culture, behaviour and attitudes of workers and employees, and the management factor.

2.7.1 Performance

2.7.1.1 Equipment Failure

Equipment failure occurs in organisations due to inappropriate physical conditions: in other words, defects in equipment and tools used in construction projects. This contributes to increasing the cost involved in different phases of the construction project. It also reduces the productivity of employees as they have to devote more time to performing different activities (Oloke, Yu and Heesom, 2007). Breakdown and wear and tear of equipment in the organisation causes accidents and injuries to employees mentally or physically resulting in their performance being negatively affected. The performance of workers is also affected adversely due to lack of proper rest, as they have to work long

hours in the organisation. This is because of a lack of skills and abilities. It also results in delays in the work process and stoppages in the production of different products and services.

2.7.1.2 Working Conditions and Culture

The occurrence of fire and the existence of inappropriate walking surfaces have a negative impact on the health of workers and affects their performance. In addition, if workers have to work for long hours on a project continuously and do not have sufficient time to rest, their performance is significantly affected.

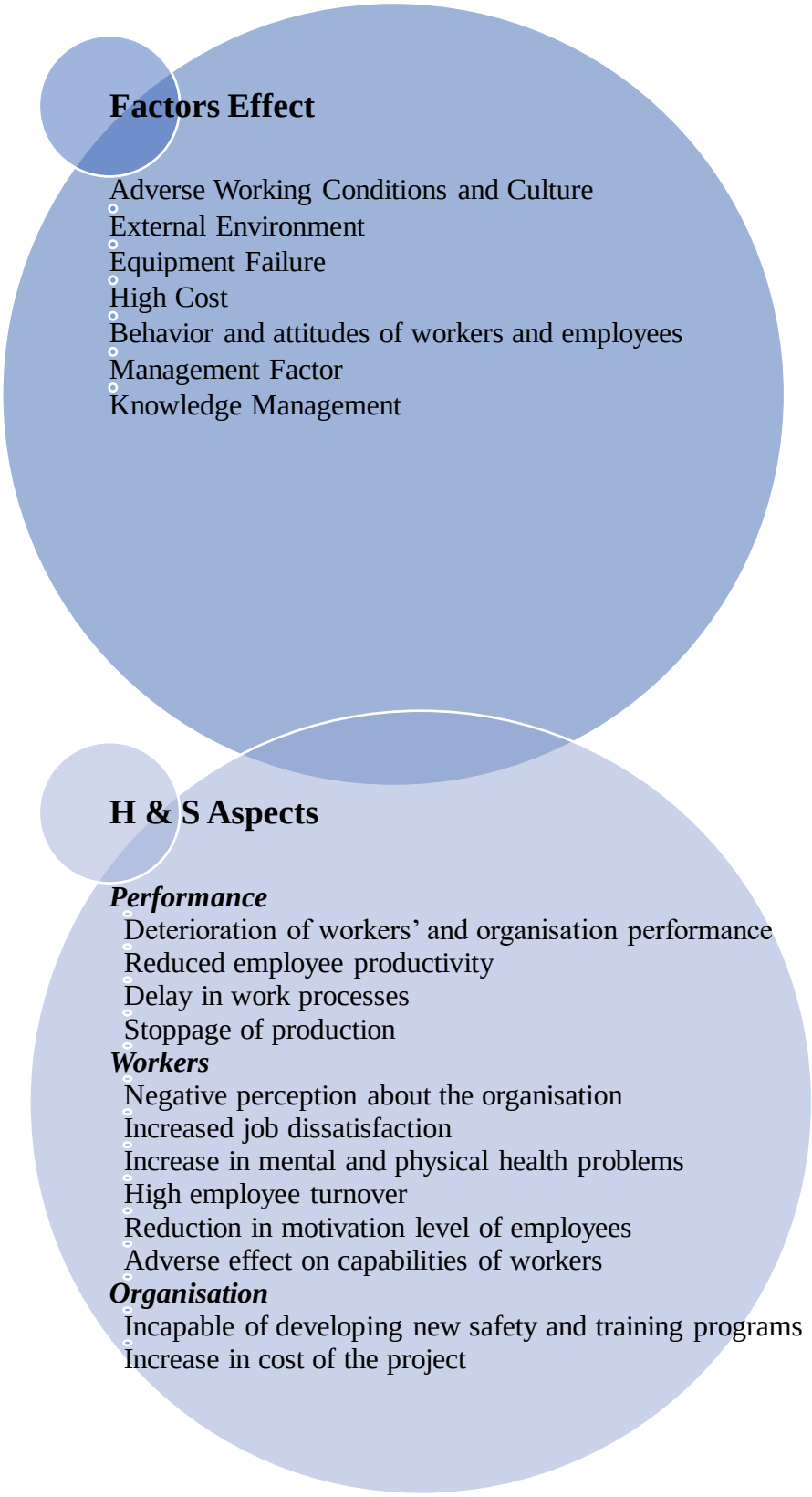

Figure 2.3: Factors affecting different aspects of H&S (Source: Chrisp and Bowles, 2012 et al.)

2.7.1.3 Behaviour and Attitudes of Workers and Employees

Adverse behaviour and attitudes of workers and employees influence them to perform unethically, which leads to a deterioration in their performance, and negatively affects the overall functioning of the organisation. It also delays the completion of the project.

2.7.1.4 Management Factors

Employees and workers in an organisation follow the instructions and directions of leaders, seniors and supervisors. This is the reason that leaders and top level managers have to adopt proper leadership styles and take into consideration all the relevant aspects for making decisions. Inappropriate decision making, strategy formulation, and leadership styles adversely affect the performance of workers, leading to delays in completing the project.

2.7.1.5 Knowledge Management

Poor knowledge management in construction projects results in delays in work processes. These delays are caused by the inadequate capturing and storage of the required data and information, which means that the limited availability of clear information on health and safety in the work environment leads to accidents that hamper the performance of workers on site (Hallowell, 2012).

2.7.1.6 Cost

There is an increase in cost, due to injuries and accidents that affect the performance of workers adversely, rendering them unable to perform their assigned tasks effectively and efficiently.

2.7.1.7 External Environment

When construction companies do not meet the standards established by the regulatory authorities with regard to the environment, the result is an increase in health problems with workers, which in turn causes their performance to deteriorate.

2.7.2 Workers Conditions and Equipment Failure

2.7.2.1 Equipment Failure

The breakdown of equipment on work sites is another cause of delays in the completion of projects, and results in a high employee turnover as workers lose faith and switch to other organisations in the market. Equipment failure at work sites also increases the probability of accidents which may cause physical and mental injuries to workers and thereby render them incapable of performing different crucial activities efficiently and effectively. Consequently, they cannot complete their assigned tasks successfully.

2.7.2.2 Working Conditions and Culture

Insufficient working space, raised structures on walking surfaces, trip hazards, poor weather conditions and inadequate welfare facilities, among other factors, reduce the motivation level of workers on site. These factors are also the reasons why various types of accidents occur in the organisation and affect the workers involved in the project adversely, both physically and mentally. There are also problems of various air-borne diseases, caused by the inhalation of many toxic substances and materials in the environment which are due to the extraction of toxic gases and other substances during the different processes carried out in the construction industry (Behm, 2006).

2.7.2.3 Behaviour and Attitudes of Workers and Employees

Another factor, as mentioned earlier, is the negative behaviour and attitudes of employees in an organisation, resulting in negative or wrong actions, which in turn lead to the

occurrence of major accidents at construction sites, and hence to delays in the completion of projects. Such accidents also happen due to a lack of knowledge and indequate skills and abilities of employees (Saleh and Ramadan, 2011). Thus the health and safety of employees is affected by the greater likelihood of physical injuries.

2.7.2.4 Management Factors

Management factors include leadership style, decision-making processes, and planned strategies that have a great influence on the workers of the organisation. Where strategies formed by top level management are not aligned with and supportive of the health and safety aspects of workers, this can be a cause of accidents at the work site. This has resulted in an increase in fatal accidents and physical injuries in employees. An inappropriate leadership style at the construction site can lead to inadequate coordination among members associated with the project.

2.7.2.5 Knowledge Management

There is abundant availability of tacit knowledge regarding the safety and security of workers from the perspective of health, but construction companies find difficulty in collect and store this knowledge. This is because it is present in the form of personal experiences, which employees resist sharing with other members of the organisation. This contributes to a reduction in the workers' performance (Hallowell 2012) and also deprives them of essential skills and abilities, which in turn reduces their motivation and satisfaction level. This results in high employee turnover in the organisation.

2.7.2.6 Cost

The increased cost of the occurrence of accidents in the construction industry reduces the overall productivity of employees and reduces their satisfaction and motivation level in

the job. An increased cost in the recruitment of new employees in the organisation also affects the behaviour and attitude of employees in an adverse manner.

2.7.2.7 External Environment

An increase in the inflation rate in the economy, advancement in technology and inappropriate or inadequate training of employees by the company reduces the motivation level of employees and increases the occurrence of accidents at work sites. It also results in a lack of required skills and abilities in employees. This in turn reduces their level of commitment and loyalty towards the organisation.

2.7.3 Organisation Working Conditions and Equipment Management

2.7.3.1 Equipment Failure

The breakdown of equipment on the project can cause the stoppage of production activities and delays in work processes, which in turn negatively affect the overall performance of the organisation. This produces a negative effect on the organisation's profitability, which in turn increases the level of competition, and so the sustainability of the business is adversely affected. Failure of equipment also increases the probability of occurrence of accidents in organisations (Oloke, Yu and Heesom, 2007). This results in a decrease in the workers' performance, and hence the overall performance of the organisation is negatively affected too. Delays in the completion of the construction project due to wear and tear of tools and equipment results in a decrease in the profits of such a project and adversely affects its sustainability in the market.

2.7.3.2 Working Conditions and Culture

The occurrence of fire at construction sites causes huge damage to the overall organisation in terms of sales, profits and sustainability (Banik, 2013). The reduction in the productivity and performance of workers also has a direct effect on the overall performance of the organisation. A reduction in the performance of workers in the organisation due to an inappropriate and inadequate work site layout and culture results in an increase in the costs incurred in the project because of the resulting delays. This, in turn, reduces cash inflows and has a negative effect on the organisation's financial performance and thus its overall sustainability is hampered.

2.7.3.3 Behaviour and Attitudes of Workers and Employees

Negative attitudes and behaviour of workers at construction sites reduces their capabilities, and results in conflicts within the organisation. This in turn adversely affects the working environment and reduces the organisation's overall profitability and productivity. Hence investors are reluctant to invest in such projects, which have a negative impact on the brand image and goodwill of the company.

2.7.3.4 Management Factors

Management mainly includes decision making and leadership. A construction project involves huge cash outlays, due to which there is a necessity for management to adopt an appropriate leadership style. Project managers should also consider all the relevant information for making decisions regarding the different aspects, in an effective and efficient manner. The adoption of a poor leadership style for managing a construction project leads to inadequate coordination and cooperation among the different workers and

employees involved in the project. This in turn results in delays in projects, which affect the performance of the overall organisation

2.7.3.5 Knowledge Management

The resistance of employees towards sharing and transferring knowledge to one another with respect to skills, abilities and other required resources results in a decrease in the performance of workers. This increases the threat of competition and affects the overall profitability of the business negatively.

2.7.3.6 Cost

Any increase in the number of accidents at a construction site increases the overall cost of the organisation as companies have to compensate their employees and workers for the injuries caused to them. It also increases the costs incurred in different activities carried out for completing the project. In this way, cost has an adverse effect on the overall performance of the organisation.

2.7.3.7 External Environment

There are circumstances in which the organisation has not fulfilled the statutory requirements of the different laws pertaining to health and safety, such as those governing the extraction of toxic substances in the environment, which has a negative effect on the goodwill and brand image of the company.

2.8 Implications for Managing Health and Safety of Construction Projects in the Oil and Gas Industry in Saudi Arabia

The review provided in this chapter indicates that Saudi Arabia has a long way to go in relation to the management of health and safety in the construction industry. These issues are due to the need for enforcing appropriate health and safety legislation, and

implementing appropriate health and safety standards as well as adopting measures to control the problem of health and safety on site. In the oil and gas industry, the risky nature of the industry coupled with the nature of the construction industry and projects make the need for improved measures towards health and safety very critical. This indicates that health and safety for construction projects in the oil and gas industry may come with more requirements in terms of ensuring the general health hazards associated with construction projects and needs to be met, coupled with meeting the hazards associated with working in the oil and gas industry.

2.9 Summary of Chapter Two

As shown in this chapter, the Saudi Arabian construction industry plays a key role in the economy of Saudi Arabia and the expansion of the oil and gas industry has led to an increase in the demand for projects in the construction industry. The chapter has also presented an overview of the health and safety implications of oil and gas construction projects in Saudi Arabia. It is essential that all the norms and regulations ensuring the health and safety of the workers are followed for the workers and contractors of the construction sector. Carrying out typical activities in the construction industry involves high-risk exposure to the health and safety of the construction workers and people working in the oil and gas sector of Saudi Arabia.

There are multiple internal and external factors that can increase risks for the workers. The lack of knowledge among the construction workers on the use of new technical equipment, the installation of mechanical instruments, the failure of equipment while working, and technical defaults expose the construction workers to high risks associated with health. Therefore, any negligence concerning the use of heavy and dangerous

devices such as escalators while working at different heights without safety measures and protection gear can result in an increase in the number of accidental deaths.

The members of the construction team must work in coordination with each other and ensure that all the activities have a proper structure for ensuring improved functionality and enhance the efficiency of the team. Effective utilisation of time, cost, and quality is essential for ensuring health and safety on construction sites for the oil and gas sector of Saudi Arabia. The increase in number of accidents not only results in loss of valuable human resources but also impacts the profitability and efficiency of the organisation. As shown in the chapter, the adoption of proper measures for managing health and safety can lead to improved health and safety performance. The next chapter develops a conceptual framework that combines the different elements of the research to provide a better understanding of the issues presented in this research.

CHAPTER THREE: CONCEPTUAL FRAMEWORK

3.1 Introduction to Chapter Three

The idea of a conceptual framework as used in research is to help bring the concepts within a study together and to propose interconnections between the concepts and how they are expected to interrelate in real life contexts. This helps the researcher to have a better understanding of the different concepts and plan for the data collection process. In the health and safety literature, a number of frameworks exist which help to contribute to a better understanding of the issues within the subject area. As presented in the previous chapter, this research focuses on health and safety management practices applicable to oil and gas construction projects. Investigating this requires a better understanding of all the variables that have a link to safety management in the oil and gas industry as well as the construction industry.

This chapter is dedicated to developing a conceptual framework based on the information gathered from the literature review on the health and safety management of construction projects within the oil and gas sector. The essence of this framework is to help present a better understanding of the nature of the problem by revealing the possible interconnections between construction activities, health and safety issues and the influence of the oil and gas sector on the health and safety issues in construction.

3.2 Frameworks on Health and Safety in Construction Sites

From the review of studies regarding health and safety in the construction industry presented in the literature, there is the suggestion that different frameworks have been developed to help explain and provide a better understanding of health and safety issues

in the construction industry. For the purposes of developing a conceptual framework for this research, frameworks in health and safety on construction sites have been thoroughly reviewed.

3.2.1 Framework for Safety - Knowledge Management Enhancement

Hallowell (2012) presents the framework for safety knowledge management enhancement depicted in Figure 3.1. It indicates that the knowledge regarding health and safety can be collected from different internal and external sources. Internal sources include self-inspection, safety stand-downs, Job Hazards Analysis (JHA) creation, accident analyses and group brainstorming. The external sources include academic publications, the American Society of Safety Engineers (ASSE), Associated General Contractors' (AGC) meetings, and so on. The information collected from these sources is stored in the form of plans, documents, videos and electronic systems. The stored information is shared and transferred to members of the organisation through different modes, such as training, committees, talks, and bulletin boards (Hallowell, 2012). Sharing and transferring knowledge by using these modes facilitates refining the information and providing the relevant information to employees in order to increase their knowledge regarding health and safety at construction sites.

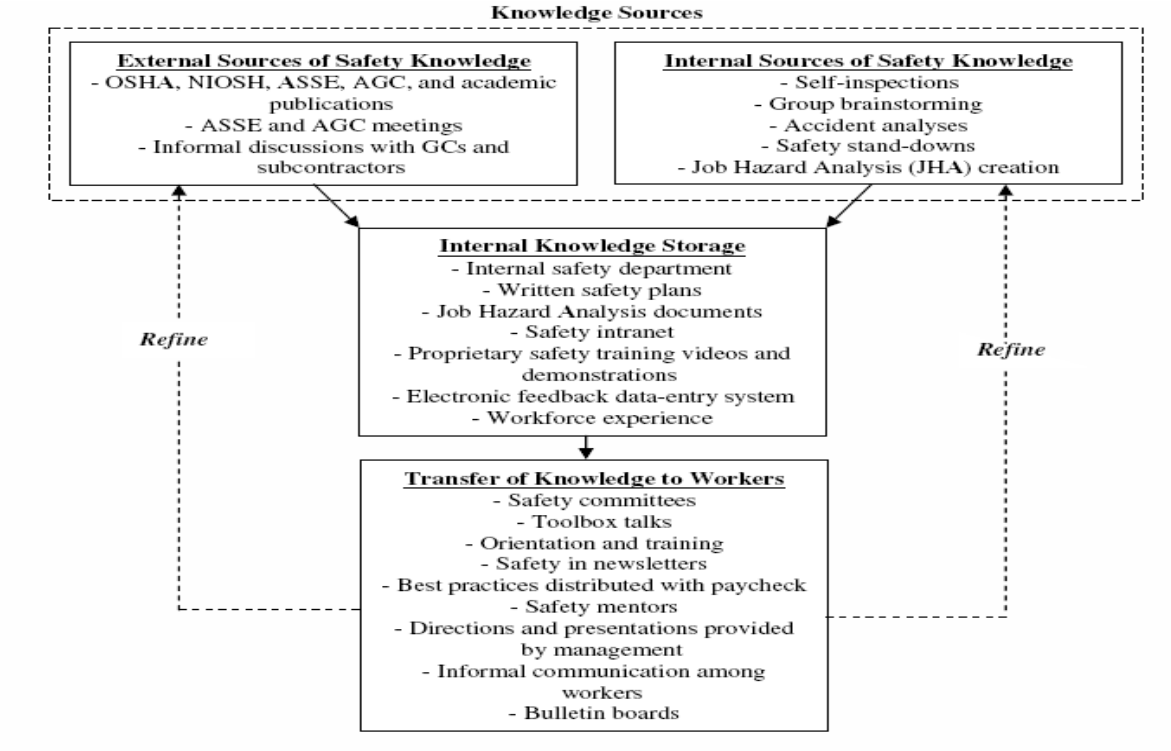

Figure 3.1: Framework for safety – HM enhancement (Source: Hallowell, 2012)

3.2.2 Framework for EFQM Excellence Model

Pungvongsanuraks and Chinda (2010) argue that the European Foundation for Quality Management Excellence Model (EFQM) focuses on increasing the effectiveness and efficiency of organisations associated with the construction industry. This model has two parts – enablers and results – which enable the quality of different business activities in construction projects to be improved. The five enablers which the model emphasises from the perspective of the construction industry include leadership, partnerships and resources, policy and strategy, and processes, which have different attributes related to health and safety in the organisation, such as safety accountability, safety rules and procedures, national safety law, safety empowerment, safety awareness, and training. The effective and successful implementation of these enablers in organisations helps in obtaining beneficial and positive results with regard to maintaining good health and safety for the different stakeholders which include customers, society and employees. This in

turn leads to maintaining the sustainability of companies (Pungvongsanuraks and Chinda, 2010) as seen in Figure 3.2.

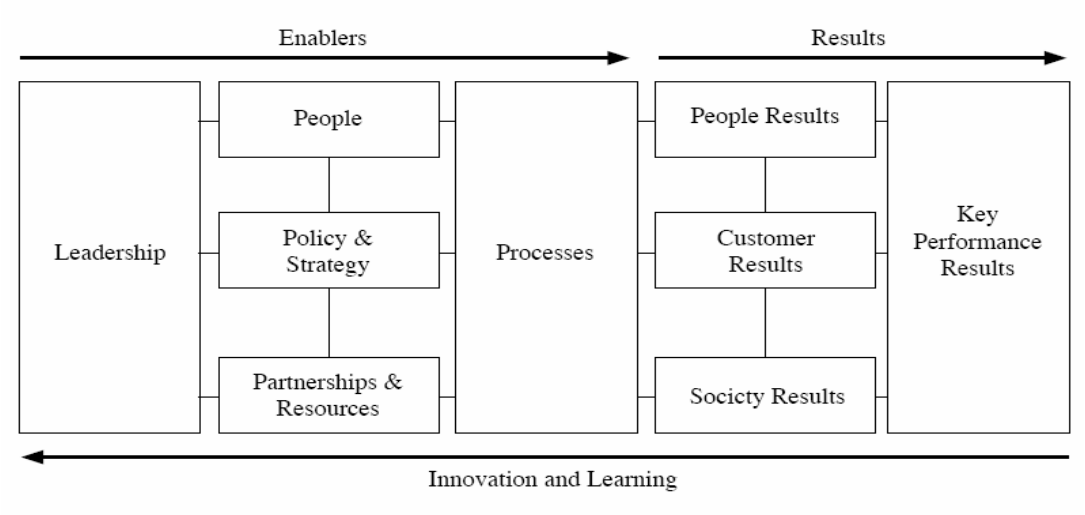

Figure 3.2: EFQM excellent model (Source: Pungvongsanuraks and Chinda, 2010)

3.2.3 Framework for the Reciprocal Safety Culture Model

Alasamri, Chrisp and Bowles (2012) state that there are three main components that are necessary for building a safety culture in the construction companies of Saudi Arabia: person, environment and behaviour. The person component of the model takes into account the employees' perception of the organisation's safety management system. It also has attributes such as interaction between people, jobs and the organisation, which aids in the creation of a safety culture on construction sites. It involves different people from different levels of the organisation, such as middle management and frontline managers (Alasamri, Chrisp and Bowles, 2012) who are responsible for various activities; for example, carrying out operational activities and decision making, so as to provide information related to the safety aspect in projects. In addition, they increase the participation of employees in the safety activities of construction projects.

The second component is behaviour, which includes the attitudes displayed by employees in different situations. At times, employees might behave and act in an improper manner which results in accidents on work sites. Therefore, there is a need for managers to direct the efforts of people towards safety, which helps to increase the productivity of employees in the organisation (Alasamri, Chrisp and Bowles, 2012).

The final component is the environment or situation that indicates the quality of operations carried out at the construction sites. There is an implementation of the safety management system which includes planning, implementing, and measuring and reviewing the safety performance of the construction sites illustrated in figure 3.3.

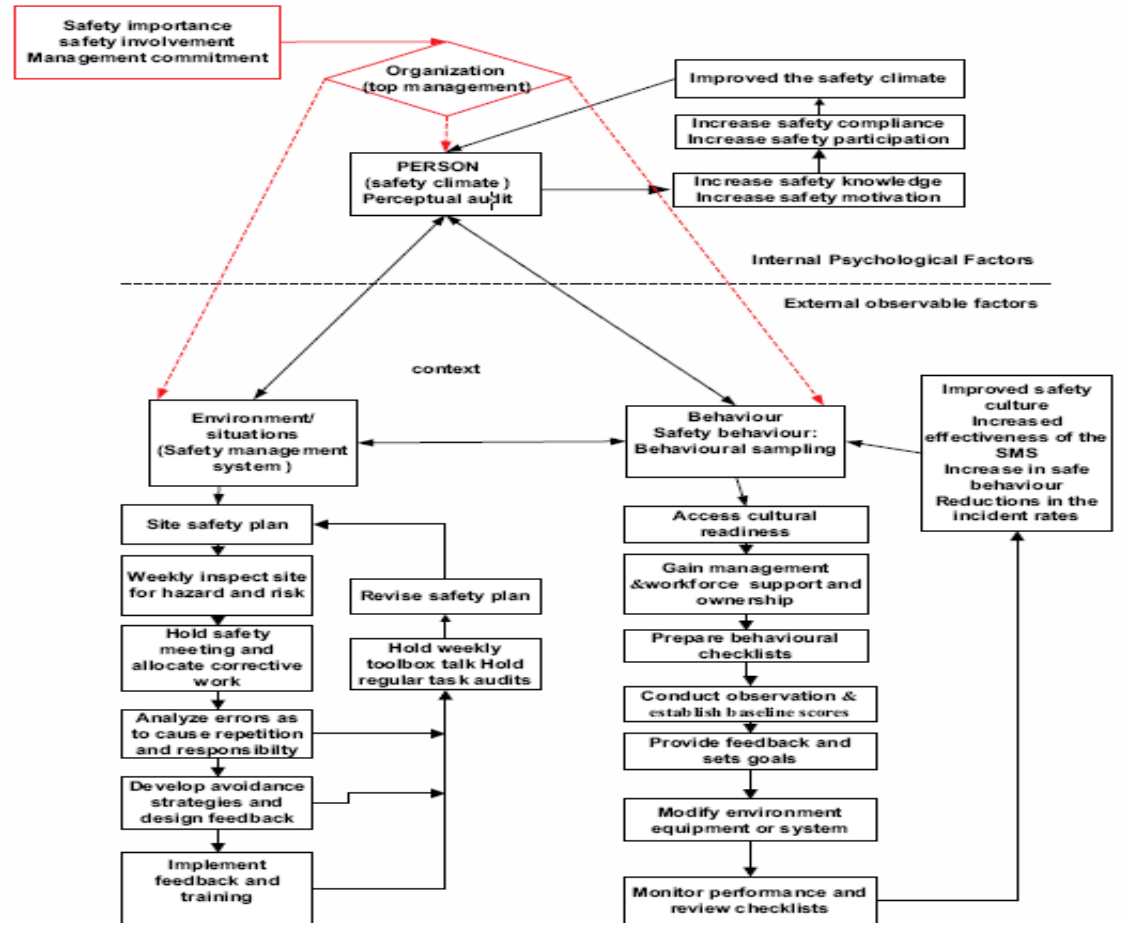

Figure 3.3: Reciprocal Safety Culture Model (Source: Alasamri, Chrisp and Bowles, 2012).

From the review of the different frameworks for health and safety management presented in this section, it is evident that the frameworks for health and safety take into account internal as well as external sources of information and this relies on both managerial (corporate) and personal level factors to ensure that safety is achieved. As shown in the review, achieving health and safety relies to a large extent on the climate for health and safety created which is made possible by having a culture that supports health and safety in the organisation. From the Reciprocal Safety Culture Model, by Alasamri et al (2012), this can be made possible by having in place a safety management system which takes into account the behaviour of people involved in the activities of the company. As shown in the model, where there is improved safety culture, this results in improved effectiveness of the safety management system in place. Similar views can be deduced from the Excellent Foundation Quality Management Model (EFQM) which suggests that the enablers of safety within an organisation will be based on the leadership action towards safety management which considers the people, the policy and the resources of the organisation to result in positive outcomes in terms of health and safety.

Based on the reviews of the frameworks stated above, the next section builds a conceptual framework for safety management in oil and gas construction projects taking into account the environment within which such construction projects take place and the likely impact of the environment on the issues relating to safety on such projects.

3.3 Conceptual Framework

According to educational researchers, a conceptual framework undertakes formation of structured work through the inclusion of broader ideas and theories in accordance with the aim and objectives of the research study. The conceptual framework supports the development of rigid literature to support the research study. In developing conceptual

frameworks, Grant and Osanloo (2014) report that the essence of the conceptual framework is to guide the research by acting as the blue print which forms the basis for building the research enquiry. As presented in Sinclair (2007), the conceptual framework can be seen as the map that guides the researcher in ensuring the research does not deviate from its aim and objectives. Considering the nature of this research, it is very important to ensure a conceptual framework is developed which would guide the key aspects of the research by helping to connect the different concepts of this research by helping to connect the dots from the review of literature carried out as well as the review of the key frameworks selected for this research. Although there is no specific formula for selecting or designing a conceptual framework, research by Simon and Goes (2011) suggests that the choice of a conceptual framework reflects the understanding of the researcher and directs the research.

Taking the above into account, the conceptual framework for health and safety management for construction projects in the oil and gas sector, considers the best approach for ensuring that health and safety is properly managed and maintained throughout the processes undertaken by construction firms working for oil and gas companies. As discussed in Haadir and Panuwatwanich (2011), there is a low level of health and safety in the construction of oil and gas projects. The literature suggests that there are many factors responsible for this current low level of health and safety management in construction projects for the oil and gas sector (see Chapter 2, section 2.3). These include issues such as poor education and the increased hazards due to the nature of oil and gas activities.

In creating a model or framework for safety management for construction projects in the oil and gas sector, it is important to ensure that all aspects of construction health and

safety, as well as all relevant components of oil and gas health and safety, are taken into consideration. From a general perspective, Choudry et al. (2007) presented the basic elements for a safety management system and suggest that such systems should begin at the policy design level and should be put in place for planning and organising the work as well as monitoring performance, so as to identify any issues that can be fed back into designing further measures for continual improvement. This is as presented in Figure 3.4.

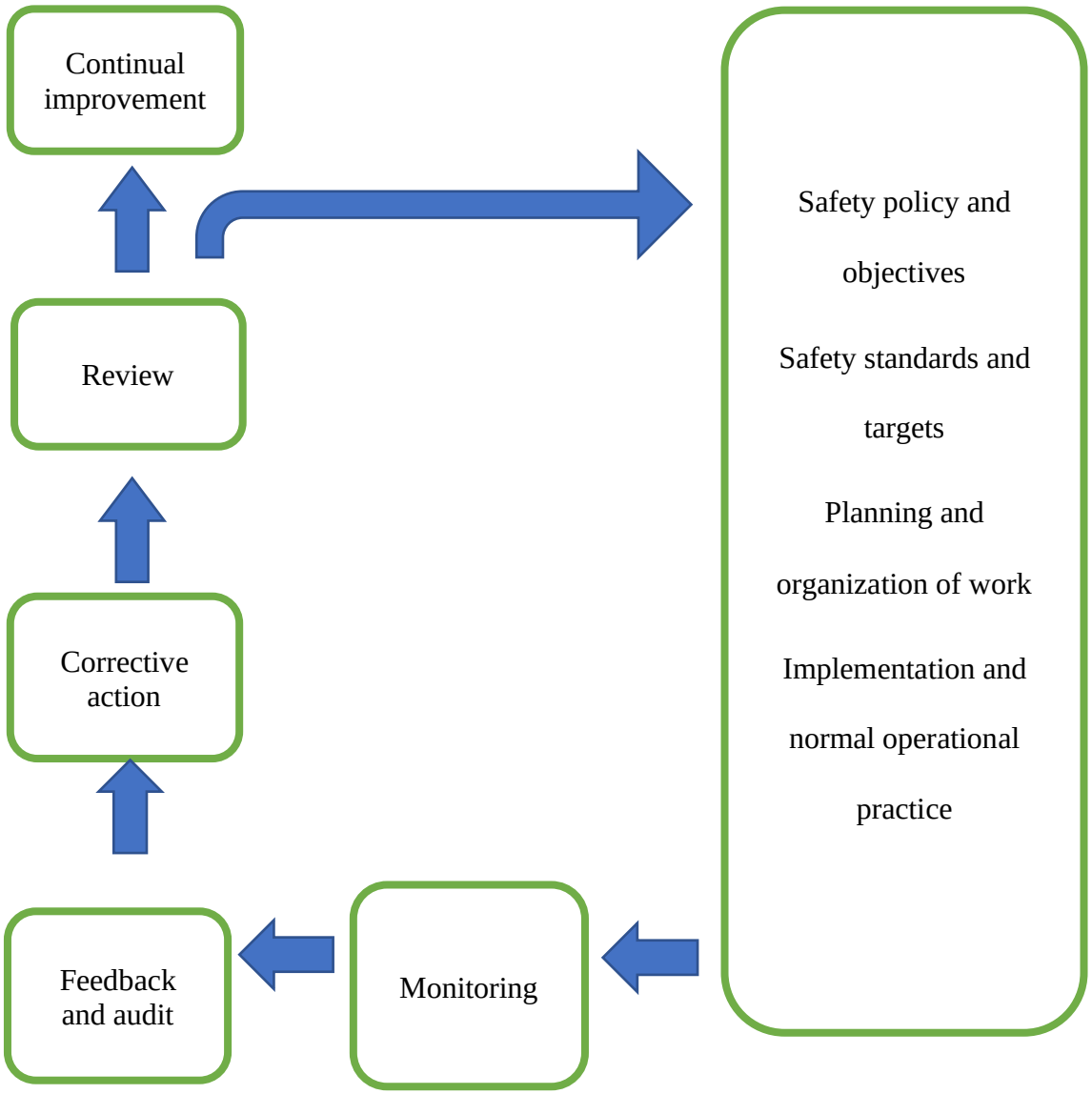

Figure 3.4: Basic elements of a safety management model. Source: Chouldhry et al (2007).

From the Basic Elements of Safety management as presented by Chouldhry et al (2007), the elements that make up a safety management model include: safety policy and objectives, safety standards and targets, planning and organisation of work, implementation and normal operational practices, monitoring of implemented practices, feedback and audit of the process, corrective action, and review and conceptual improvement. This suggests that the approach to developing measures for improving

health and safety related issues in oil and gas construction projects requires taking into account all the variables presented in this model.

3.3.1 Components of the Conceptual Framework

Based on the framework above and from the review of frameworks related to health and safety management in the construction industry, a conceptual framework was formulated for this study.

Figure 3.5 shows the proposed Conceptual Framework for Safety Management in Saudi Arabia Oil and Gas Sector. It is based on the Framework for Safety Knowledge Management Enhancement (Figure 3.1), the European Foundation Quality Management Model (Figure 3.2), the Reciprocal Safety Culture Model (Figure 3.3) and the basic elements of a safety management model (Figure 3.4). The key sections from the basic elements of the safety management model were adopted to identify which aspects of the three frameworks would best interlink to ensure safety management on construction projects in the oil and gas sector. From the different frameworks reviewed , key elements were conceptualised to contribute to ensuring safety of construction projects in the oil and gas sector. The concept was created based on literature review in Chapter 2 ensuring that all the different elements and factors contributing to health and safety management on construction projects are accounted for.

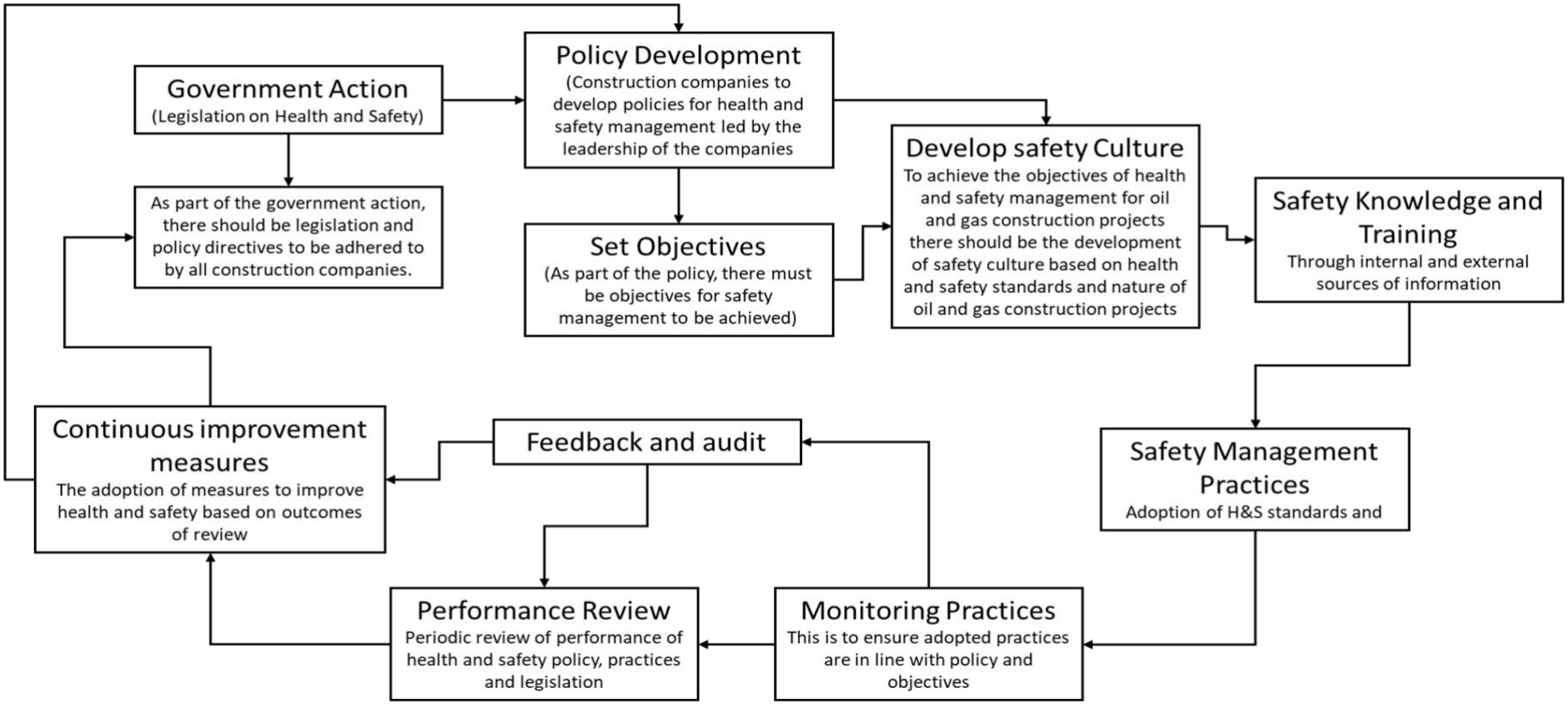

Figure 3.5: Conceptual Frameworks for Health and Safety Management in Saudi Arabia in the Oil and Gas Sector. Source: Chouldhry et al (2007).

3.3.1.1 Developing Policies and Setting Objectives for Safety Management

As shown in the model developed by Chouldhry et al (2007), the first step in developing a model for health and safety management in the construction industry is to first identify and develop policies and objectives for safety management. Developing health and safety management policies requires understanding of the processes involved in health and safety management as well as a better understanding of the problems being solved. This suggests that for the purposes of this research, it is important to consider the level of understanding of management of safety issues affecting the execution of projects in the oil and gas sector.

In the process of improving employee care and safety management in the oil and gas construction projects of Saudi Arabia, a critical investigation of the existing scenario in the industry is required. There are numerous environmental situations that support improvement in health management techniques and strategies. Working conditions in the industry need to be analysed to understand the requirements of the industry. Consistent and effective site monitoring needs to be maintained in order to understand the requirements for the development of an efficient safety site plan. After the development and implementation of this plan, it needs to be monitored for discrepancies and loopholes. A weekly inspection proposal needs to be designed to monitor developments of the plan. The report prepared after the inspection can be used for revising the plan in any required aspects. Hazards and risks involved in different processes, undertaken at various oil and gas construction projects, need to be understood (Perks, 2012). A clear understanding can support the development and revision of a site's health and safety management plans. Monitoring and planning can help managers to deploy people with the relevant potential skill sets to the appropriate site

locations. The conceptual framework can support the systematic development of health and safety programmes in the oil and gas construction projects in Saudi Arabia as shown in Figure 3.5. The analysis of errors in the current health and safety programme can furnish the development of various strategies that can be used to avoid critical accidents and casualties. Regular meetings need to be conducted to understand responses from the workers, and the information gathered can be further used to revise the programmes (Badiru and Osisanya 2013).

Top management in oil and gas construction projects need to take care of the management of safety and personal health. Management committees undertake the improvement of safety in relation to the climate at the work site. They also need to undertake different levels of safety compliance and the participation of employees in terms of safety. Motivation to adopt safety measures and the enhancement of knowledge about safety drivers can support improvement in the management of safety practices. These are a few of the psychological factors that are responsible for the development of management and improvement safety policy and measures. The management of safety procedures can be directed through the improvement in the employees' safety behaviour while working in the oil and gas construction projects.

Top management, involved in the working and control of safety measures, need to make sure that people working in the oil and gas construction projects are ready to accept safety measures (Rowlinson, 2004). Support from people working on construction sites can be useful in improving safety management skills. A behaviour checklist can be used to support the development of these safety and health practices; this can be further used to collect feedback from people to improve the working of the equipment or system used in safety

management system. Improvement in the safety culture of employees can be used to improve the effectiveness of the safety management system and a reduction in the number of accidents (Karmis 2001).

As presented in Yorio et al (2015), the need for policies on health and safety is very important due to the role played by management in the health and safety management process. This ensures there is a consistent approach to health and safety which can influence the entire culture of the organisation towards health and safety.

3.3.1.2 Culture and Safety Management Behaviour

From the review of literature, it was evident that safety management has a lot to do with culture and behaviour. This suggests that to ensure the best approach is taken for safety management on oil and gas construction projects, there is a need to focus on building a safety management culture which is made possible by changing behaviours. This is made possible through the development of measures towards creating a safety culture for organisations. The establishment of safety culture is made possible through the adoption of safety management standards and setting up programmes directed at improving safety in the organisations.

3.3.1.3 Safety Knowledge and Training As shown in chapter two, there is the need to ensure that the workforce has the correct level of safety knowledge to adhere to correct procedures required?

Health and safety policies. This will require knowledge from internal as well as external sources of knowledge. The sources of health and safety knowledge, as shown in the literature, can be from internal and external sources including but not limited to Occupational Safety and Health Administration (OSHA), National Institute Occupational Safety and Health

(NIOSH), and academic publications, the American Society of Safety Engineers (ASSE) and Associated General Contractors (AGC) meetings. Internal sources also include: self-Inspections, brain-storming in groups, accident analysis, Job Hazards Analysis (JHA) and efforts at encouraging and creating safety behaviour through training and the education of team members.

3.3.1.4 Government Legislation

From the discussion in the previous chapter, it is also evident that government legislation has a critical role to play in health and safety in oil and gas construction projects since legislation ensures strict adherence to the required standards.

3.3.1.5 Monitoring of Safety Management Practices

Section 2.4.2 suggests that a key component of every health and safety management system is the need for safety management standards which serve as the basis for monitoring and controlling health and safety management against the required levels or standards. As discussed by Govindan et al (2015) and Su et al (2018), different standards are developed and adopted in different industries to aid the management of health and safety.

Management of health and safety in the oil and gas construction projects in Saudi Arabia therefore requires standards and practices to be in place.

3.3.1.6 Feedback and Auditing

As shown in the framework by Chouldhry et al (2007), there is a need for feedback and auditing as part of the measures to improve safety practices. This will ensure monitoring of safety practices and reporting the outcome of the monitoring. Feedback and auditing

provides a means to identify and determine the corrective action that must be taken to overcome any existing issues of high levels of safety incidents.

3.3.1.7 Corrective Action

A very important element of the framework for health and safety management is the need to ensure measures are put in place to lead to corrective action to guarantee safety practices. Corrective action can be from internally generated solutions (innovative solutions) or the adoption of measures applicable from other industries and sectors.

3.3.1.8 Review of Safety Management Measures and Continual Improvement

To ensure that safety management measures achieve the needed results and meet the goals of safety management policies, there is a need to review performance from time to time to ensure continuous improvement. The frequency of the review should be based on the performance of the safety management measures.

The essence of the review is to ensure continual improvement by influencing the health and safety policies and measures adopted by construction firms. This is also expected to influence government policies and legislation on health and safety in oil and gas construction projects.

Based on the discussion provided above, the conceptual framework for health and safety management in oil and gas construction projects in Saudi Arabia is developed.

The implementation of the various aspects mentioned in the conceptual framework will support the development of better safety management systems in the oil and gas construction projects so as to minimise the number of accidents. The process for development of safety systems involves industry leaders, employees, policy and strategy developers, customers and

other stakeholders. The process is the result of the participation of these people, who are the enablers, and others who are interested in the outcomes. Thus, the conceptual framework describes the structured format that will be followed for the development of the research study.

3.4 Impact of the Conceptual Framework on Data Collection

The conceptual framework has been developed from a synthesis of the review of data on the subject carried out in Chapters 2 and 3 of this thesis. Based on the synthesis, it is evident that the health and safety management of oil and gas construction projects have many aspects that need to be taken into consideration for the Saudi Arabian oil and gas construction projects.

Overall, the conceptual framework highlights a number of issues that need addressing in order to formulate a substantive framework. These include:

- the approach taken by construction firms operating in the oil and gas sector in Saudi Arabia towards defining policies for health and safety management
- the current government policies towards achieving health and safety in the oil and gas construction projects
- the types of organisational safety culture developed for oil and gas construction projects
- measures adopted to train and encourage safety behaviour on oil and gas construction projects
- health and safety standards adopted for ensuring safety on oil and gas construction projects in Saudi Arabia

- monitoring and performance review strategies adopted
- continuous improvement measures adopted

These key components of the conceptual framework formed the basis for designing the research instrument which helped to collect and analyse data to develop a best practice framework.

3.5 Chapter Summary of Chapter Three

As shown in this chapter, the need for a conceptual framework for this research cannot be over emphasised considering the nature of the research. The chapter has reviewed existing conceptual frameworks for health and safety management, the impact of the nature of the oil and gas industry on the conceptual framework developed for this research, and the likely interactions within these concepts. Based on this information, a conceptual framework has been developed for this research and the likely issues to be addressed through the data collection phase. The chapter has helped to shape the next stage of this research, the data collection stage, and has identified key areas to be considered throughout the process.

The next chapter discusses the methodology adopted for proceeding with this research by reviewing the best approaches for data collection and analysis.

CHAPTER FOUR: RESEARCH METHODOLOGY

4.1 Introduction to Chapter Four

To answer the research questions and to meet the objectives of this research, it is very important to ensure appropriate research methods are identified and correctly applied. As reported in Creswell (2009), research design forms the blueprint for undertaking the research by linking the outcomes to the aim and objectives. This means that having the appropriate research design is integral to the success of any piece of research. As part of the research design, the process of data collection needs to align with the research question, aim and objectives in a particular format suitable for the research study, to ensure the development of good research outcomes (Chapman, 2005). This chapter discusses the subject of research design and explains the basis for the use of mixed methods for data collection and analysis. Approaches taken to collect data will be discussed, including the pilot data collection and how the conceptual framework developed in the previous section influences the design of the data collection instruments as well as the analysis of the data. The chapter is divided into seven main sections. The first section discusses the subject of research design followed by the second section the methodological paradigms adopted for research. The third section discusses the research strategy and the strategies adopted for undertaking this research. This is followed by the approach to data collection, including the ethical considerations, and sampling strategy. The last three sections discuss the qualitative aspect and quantitative aspects of this research, followed by the approach taken for data analysis.

4.2 Research Design

Research design is used by a researcher to undertake the analysis of the whole research process in order to develop an integrated structure for the complete research study. It is the overall structure that guides the researcher in the manner in which he/she obtains answers to the question addressed in a research study (Cresswell, 2009). Polit and Hungler (1999) explicitly explain that research design is the process that specifies the type of research approach to be employed and how the researcher plans to employ scientific controls that will enable successful interpretation of the data and analysis of results.

The selection of different research designs depends on the requirements of the research study. Designs are never selected on their individual significance and effectiveness; however, they are selected on the basis of the core requirements of the complete research process. An effective research design holds the complete research process in a comprehensive structure (Zikmund, and Babin, 2006). Therefore, to enable appropriate research, Creswell (2009) opined that every research design must include an intersection of three important elements known as the methodological paradigm (philosophical worldview), the research strategy and specific research methods.

4.3 Methodological Paradigms

Paradigms are set of basic beliefs that lie behind legitimate enquiries and control a given set of scientific action or procedures (Rohan, 2011). According to Weaver and Olson (2006, p.5), "Paradigms are patterns and practices that regulate inquiry within a discipline by providing lenses, frames, and processes through which investigation is accomplished." There are two major research paradigms in social research studies. These are known as positivism and interpretivism (Kumar, 2015).

The choice of which paradigm to adopt largely depends on the nature of the research and the condition that surrounds it (Pollack, 2007). Positivism is based on the quantitative rules of logic and measurement of human behaviour with consideration of key principles, variables, predictions and truths.

Interpretivism, according to Hammersly (2012), focuses on the interpretation and understanding of how people think, view and feel about the world by finding out how to grasp diverse points of view in their own terms. This suggests that a positivist believes that there is one objective reality and this can be studied, experimented and even modelled, whereas an interpretivist believes that reality is subjective and can therefore be seen and interpreted from different perspectives (Sutrisna, 2009). With positivism, the researcher is usually not part of what is being investigated. However, with interpretivism the researcher is part of the research process and therefore usually influences the outcome of the study. Table 4.1 succinctly illustrates the key differences between the Positivist and Interpretivist paradigms.

Table 4.1: Difference between Positivism and Interpretivist paradigms (source: Sutrisna, et .,2009 Hammersly et al.,2012)

Positivism	Interpretivism
The observer must be independent	The observer is part of the research process
One truth exists	Many truths and realities exists
Beliefs must be objective	Beliefs that different people have different needs, experiences and perceptions
Requires large sample selected randomly	Requires small number of cases selected for particular reasons
Generalization through statistical probability	Generalization through theoretical abstraction
Quantitative research method	Qualitative research method
Illustrates causality	Helps to deeply understand a situation

Reviewing Table 4.1, and comparing the content with the objectives outlined in Chapter 1 of this study, it is obvious that both objective and subjective points of view are needed to obtain an informed conclusion for this study.

After identifying the research paradigms, it is important to decide on the correct approach and methods that can help the research collect and analyse the correct data for meeting the objectives of the research. For successful completion of the research study, the concept of the research approach needs to be understood. Among numerous research approaches, three main knowledge claims or research methods are used to undertake social science research. These are quantitative, qualitative or a mixed methods approach. Research approaches are not decided on the basis of their efficiency or effectiveness; however, approaches are chosen based on how much they are in accordance with the research questions, aim and objectives (Gratton, and Jones, 2010). In accordance with the requirements laid out by the research question, aim and objectives of the research process, thorough examination of the three

aforementioned knowledge claims are carried out to ascertain the one that best suits this study.

4.4 Research Methods

The research method is among the three important elements that must be included in every research design. This is simply because research methods are strategies that provide particular directions on how to achieve the aim and objectives in research (Cresswell, 2009). There are three popularly known research methods within social research studies, and these are quantitative, qualitative and mixed method of research (Sukamolson, 2007). At the heart of these aforementioned modes of enquiries lie other philosophical assumptions such as ontology, epistemology, methodology, axiology and rhetoric.

Ontology focuses on describing what knowledge entails and what its origin is. It questions the very nature of reality. There are two major ontological views; namely objectivism and constructivism. The former is associated with the positivist paradigm, while the latter is closely related to the interpretivist paradigm (Cresswell, 2009). Epistemology, on the other hand, questions the very prospect of knowledge. It deals with the scope of knowledge and seeks to identify the relationship between a researcher and the object being researched (Bryman, 2008). Hammersely (2012), states that the epistemological stance in positivism specifically shows that the researcher is independent from what is being researched while, in that of interpretivism, the researcher interacts with the object being researched.

The philosophical assumption that deals with the procedures on how knowledge should be sought out is methodology (Hammersely, 2012). Grix (2010) said that without a prescribed systematic approach, prescribed objectives cannot be achieved. In qualitative methodology,

cause and effect are obtained through an inductive approach, whereas in quantitative methodology; they are obtained through a deductive approach.

Axiology, as part of a philosophical assumption, is concerned with the study of value which includes aesthetics and ethics. The role of value in the quantitative method is free and unbiased; however, in the qualitative method, value is laden and biased (Cresswell, 1994). Lastly, rhetorical assumption focuses on the art of language. It addresses the question on what constitutes the language of research. In quantitative research methods, the research language is formal and based on a pre-determined definition and impersonal voice. On the other hand, research language in the qualitative method is usually informal and emerges from evolved decisions and personal voice (Sukamolson, 2007).

Having explained the methodological paradigms and philosophical assumption in social research studies, it is now appropriate to explore the most suitable research method to adopt in this study.

4.4.1 Quantitative Research Method

Quantitative research methods are predominantly used in social and experimental research (Kerlinger and Lee 2000). It is deductive in terms of the literature and theories, and shares its philosophical foundation with the positivist paradigm (Creswell, 2009). Synonymous to positivism, quantitative research illustrates that there is a single objective reality or truth out there in the world and these factors of truth and reality are driven by undisputable natural laws that are not based on human perceptions but rather predictions and measurements (Biggam, 2015). Fellows and Liu (2008) also justified that the quantitative method is better at testing objective theories through examining relationships among sets of variables. In

essence, it investigates social or human problems by testing theoretical assumptions after the collection and analysis of empirical data to ascertain whether a predictive generalisation of a particular theory is valid (Abdulai 2007; Creswell 2003, 2009; Bashir, 2013). Advocates of quantitative research methods usually collect instrument-based data through the use of questionnaires while analysing the data through mathematical-based methods. There are various types of quantitative research as opined by Fellows and Liu (2008), and these are experimental studies, research surveys, causal-comparative research and correlational research. The most commonly used type of quantitative research are experimental research and research surveys.

Experimental research usually tests the impact of a treatment based on a pertinent outcome by controlling all other factors that may influence it. It is basically a scientific approach that aims to determine whether a specific treatment influences an outcome (Cresswell, 2009; Manu, 2012). In this type of quantitative research, an independent variable is observed usually for a long period, manipulated and controlled by the researcher or anyone involved in the research (Kumar, 2014). This, in part, explains the huge cost implications associated with this type of quantitative research. Experimental research is mostly used in physical science and health related research studies.

Research surveys, as a quantitative research method, enables quantitative or numerical description of trends, attitudes and opinions of a population by investigating the phenomenon behind the sampled population (Creswell, 2009). It allows the researcher to collect a large number of data in a relatively short period of time from people in their natural settings. Consequently, it is not as expensive as undertaking experimental research. There are two

types of research surveys; namely longitudinal and cross-sectional surveys. In longitudinal surveys, data is gathered at different occasions and over a long period. Therefore, there is room for change of measurements in terms of variables over time. However, cross-sectional surveys are employed where variables cannot be controlled or manipulated. This is because all the data for the research is gathered within a relatively short period. This assertion was confirmed by Kumar (2014) who said that cross-sectional surveys are less costly to undertake than longitudinal surveys as they provide a snapshot of variables at a particular point in time.

4.4.2 Qualitative Research Method

As opposed to quantitative research methods, qualitative research is inductive in terms of theories and literature, and shares its philosophical foundation with the interpretivist paradigm. Synonymous to interpretivism, qualitative research supports the belief that both reality and truth are manifold. Thus, reality is subjective and constructed by characters or actors in the research (Biggam, 2015). According to Creswell (2009), qualitative research involves exploring a phenomenon in order to understand a social or human problem while using emerging flexible questions and procedures to elicit data from participants in their natural setting.

Additionally, Creswell (2009) iterated that through a qualitative approach, the researcher has the opportunity to explore and understand the meaning of individuals or groups assigned to a particular phenomenon. Based on the ontological position of social constructivism, the qualitative research paradigm suggests that the researcher gets close to the subject matter under inquiry (Abdulai 2007; Bryman 2008; Neuman 2006; Bashir, 2013). This however, is contrary to the position held by the ontological position of objectivism (i.e. quantitative

paradigm) which rejects the practice of getting too close to the subject matter because of the possibility of influence and subjectivity. However, advocates of qualitative research responded that there is no harm done in getting close to the people or object under study with the sole intention of learning and understanding their point of view (Hammersly, 2012). This statement is backed by that of Kumar (2014) who stated that the major advantage of the qualitative method is the ability to obtain descriptions and narratives of experiences, and feelings and opinions through a flexible, open and unstructured manner usually done in close contact. Several types of qualitative design exist such as grounded theory, ethnography, phenomenology, narrative and case study design. These approaches rely on four distinctive methods of data collections namely:

1. In-depth interviews
2. Long term observations
3. Direct Participation and,
4. Content analysis of document and material culture.

These types of qualitative design can be explained below.

4.4.2.1 Grounded Theory

In grounded theory, a general abstract theory is developed using views of participants in relation to actions, behaviours, interactions etc. (Cresswell, 2014). Grounded theory involves a process of data collection at multiple stages in which the researcher can identify similarities, differences and interrelationships among the categories of information (Strauss and Corbin, 1990).

4.4.2.2 Ethnography

Ethnography involves an in-depth study to observe or investigate what people actually say or do (Creswell 2006). It is the study of an entire cultural group in a natural setting over a long period of time. Common data collection instruments in this type of qualitative design approach are in-depth interviews and structured or unstructured observations (Creswell 2009).

4.4.2.3 Case Study

Even though case study research is a type of qualitative research, it is also adopted in quantitative method. This approach consists of an in-depth study revolving around a particular phenomenon, event, process, group of people, infrastructure, town and even an episode (Grix, 2010). According to Stake (1995) the cases investigated in research are always bounded by time and activity and the data collection instrument is usually linked to the case study.

4.4.2.4 Phenomenology

Phenomenological design involves a detailed investigation based on human experiences and their description of what constitutes a phenomenon and how to develop a meaningful pattern to address that phenomena (Hammersly, 2012). This statement is consistent with that of Cresswell (2009) who stated that phenomenological research is concerned with the principle of human experiences in accordance with a phenomenon described by participants. In this type of qualitative research, the researcher abandons his/her experience in order to understand that of the research participants (Nieswiadomy, 1993; Manu, 2012).

4.4.2.5 Narrative Research

In Narrative Research, the researcher studies the life of one or more individuals by asking them to narrate stories about their lives. The researcher then rearranges the information in a systematic, chronological and organised manner that gives meaning and reflects both the narrators' and researchers' views (Creswell 2003). Good examples of narrative research are biographies and autobiographies.

4.4.3 Mixed Method Research

Mixed methods research has gained popularity among many social science researchers. As the name implies, it is a combination of quantitative and qualitative research methods in a single or multi-phased study (Tashakkori and Teddlie, 1998; Morse, 2003). This approach to social enquiry is based on the philosophical stance of pragmatism, which advocates the combination of philosophies or research methods to investigate a social problem (Denscombe 2007). According to Kumar (2014), mixed method research was designed with the belief that different paradigms and methods have different strengths and weaknesses, and in most cases their combined strength can provide significant positive outcomes. Another advantage of this method, according to Grix (2010), is that it uses the flexibility of each method to complement the other.

However, various researchers have criticised this method and they particularly questioned how this approach can be used collaboratively because of the fact that they have opposing principles. To this effect, Creswell (2009) explained that the quantitative and qualitative research approach can be used sequentially, concurrently and transformationally. Similarly, Grix (2010) stipulated that one can use a qualitative in-depth interview and back it up with a

questionnaire survey which could then be analysed using a mathematical based method. Table 4.2 shows the differences between quantitative and qualitative methods.

Table 4.2: Difference between quantitative and qualitative method (Source: Cresswell *el al.*, 2009, Kumar *el al*,. 2014).

Quantitative Research Method	**Qualitative Research Method**
More objective	More subjective
Number-based	Text-based
Statistical test are employed	No statistical test
Deductive: test proposed theories	Inductive: generated theories
Representative sample	Small sample- interview, direct data collection
More generalisable	Less generalisable
Method include surveys, structured observations and interviews, reviews of documents or records for numeric information	Methods include in-depth interviews, focus group, and reviews for types or themes

As presented in Tashakkori and Creswell (2007, p 4), mixed methods may be defined as research in which the investigator collects and analyses data, integrates the findings and draws inferences using both qualitative and quantitative approaches or methods in a single study.

4.4.4 Choice of Research Methods

From the discussion of different research approaches in the previous section, it is now convenient to illustrate how the research method for this study was selected. With regards to

published best practices, it is recommended that the choice of a particular research method must be supported by the clear basis for its adoption (Hammond 2006). Several reasons are usually considered when selecting a research approach. The main reasons according to the literature, include the nature of the research problem, the aim and objectives, the availability of resources and the personal experience of the researcher (Abdulai 2007; Bashir, 2013).

In line with the above recommendations, a pragmatic philosophical stance that involves the combination of both quantitative and qualitative methods (i.e. mixed methods) was chosen for the study. The rationale for the choice of this method is that the researcher can look at the research through both the objective and subjective points of view while at the same time combining the strength of both methods to complement the weakness of the other. The simultaneous use of both these methods supports a wider understanding of the research problem. The use of quantitative and qualitative methods will contribute towards the development of a better safety management system. According to Grix (2010), the use of both methods to improve the quality of the research study also promotes a greater understanding of the findings in the research study (Axinn and Pearce, 2006).

The choice of quantitative method was inextricably linked to the research question addressed in the study. The research question reads “to what extent are the existing health and safety programme undertaken within the oil and gas construction projects considered viable and effective. From this question we can infer several explanations such as:

1. There is a need to obtain information, views or perceptions of professionals on what type of health and safety programme or measures are employed or organised, how they are employed, and the extent to which they are employed.

2. It is obvious that the research will require a lot of data from participants which will make the outcome more reliable.
3. Considering the fact that this is PhD research, there is a time limit assigned to the research.
4. There is a need to generalise the findings at the end of the research

Looking at the first inference from the research question, the questions addressed are of a quantitative nature as it aims to discover the perceptions of professionals in the current practices of health and safety in the Saudi Arabian oil and gas construction projects. Furthermore, the word 'extent' requires a certain measure of variables. This is typically suitable for quantitative research methods which involve numerical and objective measurements to address questions mostly related to what, how much, and how many (Fellows and Liu, 2008). From the second deduction, it is a known fact that quantitative methods focus on larger sample sizes which are usually representative of a larger population (Kumar, 2014); therefore, this factor also influenced the researcher's decision.

Looking at the third inference, a quantitative research approach is particularly suitable as it provides a chance for a snapshot of variables at a particular point in time while targeting a large sample size (Kumar, 2014).

Lastly, the aim of the researcher is to generalise the findings regarding the appropriate health and safety measures that would prevent the prevalence of accidents in the Saudi Arabian oil and gas construction projects. According to Fellows and Liu (2008), quantitative research methods are more appropriate for making generalisations across a population. These points clearly show the relevance of employing quantitative methods.

According to Weaver and Olson (2008), qualitative methods are more suitable when aiming to understand or interpret how people think, perceive and feel about an issue that is of concern to them in their natural setting. Creswell (2009) also confirmed this assertion as he iterated that human and social problems are best investigated using qualitative methods as it gives room to obtain description and narration of experiences, feelings and opinions. Since this research entails developing a model for health and safety management in the Saudi Arabian oil and gas construction projects, there will be a need for participant input in the form of descriptions, explanations, narrations of experience, feelings and opinions. Thus, some degree of flexibility will be required in the form of follow up questions to obtain in-depth information, and the best way to acquire this flexibility is through a qualitative method notably a semi-structured interview. Therefore, a qualitative method was also adopted in the study.

From the foregoing discussion, a mixed method of research was more suitable to achieve the research aim and objectives of the research and was therefore chosen. In addition to the above discussion, Table 4.3 clearly outlines some of the merits of using the mixed research method (Denscombe, 2010).

Table 4.3: The merits of using the mixed method of research

Merits	Description
Improved confidence and accuracy	The findings from both literature and qualitative method were further confirmed using the result from the quantitative method. This instilled confidence in the accuracy of the findings
Exploration and Generalisation	The qualitative method was used to explore and identify the feelings and opinions of the participants on H&S through follow-up questions. While a quantitative method was used to their assertions and generalise the findings.
Validity	The quantitative method was used to confirm the validity of the research findings and the proposed framework for health and safety.
Broad findings	The qualitative method helped to obtain in-depth phenomena in the research while the quantitative method helped to broaden the findings.
A more rich and complete picture	When the findings from the qualitative study were added to that of the quantitative method, a richer and complete picture emerged with a full account of every relationship explored
Complementing the strengths and weaknesses of both methods	For example, the quantitative method solicited the opinions of professionals on the health and safety measures that should be employed on site, but failed to ascertain an in-depth knowledge of how these measures could be integrated into the health and safety plans of the organisations.

4.5 Research Strategy

Having chosen the mixed method approach, the next step is to determine a strategy about how to employ a mixed method of research. There is a different design of a strategy for undertaking mixed methods (see Doyle, et al 2009). As shown in Figure 4.1, the strategy for mixed methods research is based on the timing of qualitative and quantitative methods, the weighting of the two methods and the extent to which the two methods are mixed in a study.

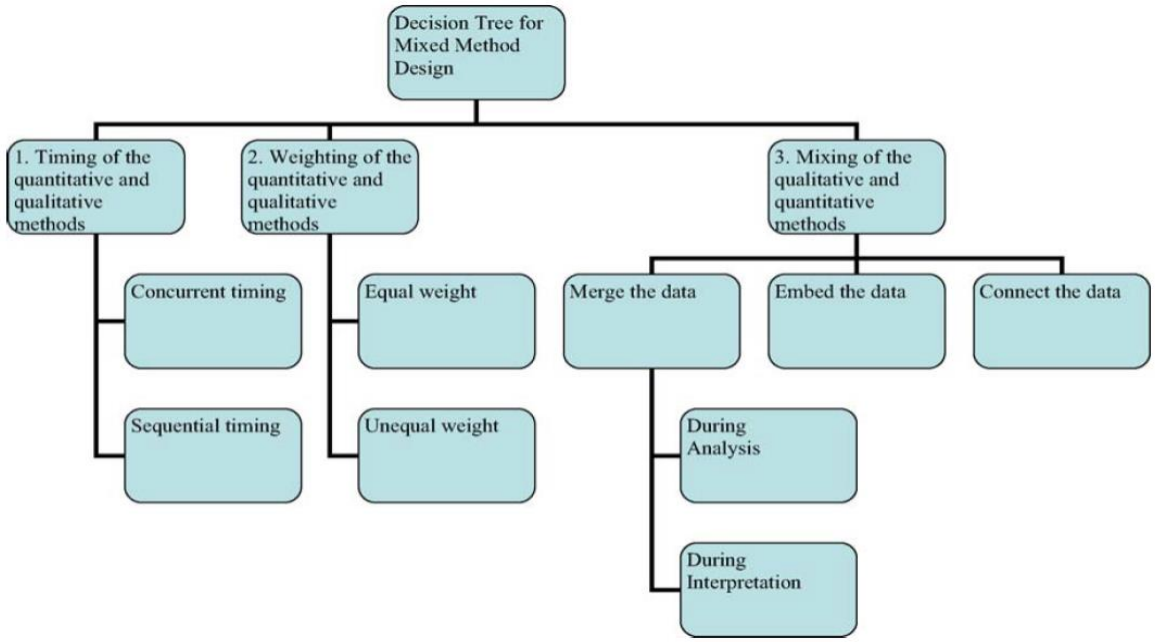

Figure 4.1: Strategy for mixed methods research (Doyle, et al, 2009)

According to Figure 4.1, there are two main strategic options in terms of the timing of the methods – the sequential and the concurrent approaches. The sequential strategy or design involves adopting a particular research method and then triangulating it with another method (Creswell, 2009). In essence, a researcher can apply a quantitative method to determine a phenomenon and then follow it up with the qualitative method to find out a narrative or in-depth opinion on the phenomenon. This can be applied vice-versa. As for the concurrent

mixed method strategy, both quantitative and qualitative methods are merged together to collect data in the same period in order to provide a comprehensive analysis and examination of the research problem (Creswell 2009). Beyond the sequential and concurrent strategies, there is a transformational strategy, a theoretical lens that serves as an overarching perspective in a research design that is used to collect both quantitative and qualitative data. In terms of weighting, the qualitative and quantitative methods can be weighed either equally or unequally depending on the design of the research. Doyle et al (2009) reports that the mixing of the two different methods can be done by merging the data either during the analysis of the results or the interpretation of the results. This can also be done by embedding the data or connecting the data (Creswell and Clark, 2007).

Having considered all the mixed method strategies, this study collected the quantitative and qualitative data in a sequential order while starting with the qualitative approach followed by the quantitative approach. Using this approach, three steps were followed.

The first step involved reviewing literature on the existing research on health and safety management in the global construction industry and, in particular, the Middle East construction industry (see Chapter 2). This led to the development of a theoretical understanding of the situation of health and safety management and also to identify several factors that influence safety programme that have been employed in previous studies. The literature review was vital as it helped form the development of the conceptual framework guiding health and safety in Saudi Arabian oil and gas projects (see Chapter 3). Furthermore, the information gathered from different literature sources and the areas discussed during the development of the conceptual framework was used to structure the semi-structured

interview and the questionnaire content to ensure the data obtained was sufficient to answer the research questions and to fill the gaps identified from the literature review (Bringle, Hatcher, and Jones, 2012). The survey questions were developed to ensure all aspects of the conceptual framework were addressed.

The second step involved the use of qualitative methods, in particular, the semi-structured interview. The semi-structured interviews were designed with construction professionals working in the oil and gas construction projects and who have considerable experience in health and safety matters. Among the areas investigated were the effectiveness of health and safety measures within nine oil and gas construction companies of different sizes, operating in Saudi Arabia. The importance and benefits of applying to them were explored as were the reasons for applying them, the role of the interviewees' organisation in preventing exposure to health and safety risks, and the necessary measures that need to be employed to prevent the prevalence of accidents on construction sites.

The final step involved the use of quantitative methods in particular questionnaire surveys. The survey targeted participants who have some experience and could therefore answer questions on health and safety.

4.6 Data Collection

This research undertook a sequential design, qualitative and quantitative approach to data collection conducted with an emphasis on gathering the right data to support the objectives of the research. The main objective of the data collection process was to obtain information from participants on the research questions. (Sapsford and Jupp, 2006). Different methods require different forms of data collection. In essence, the instruments and processes used to

collect qualitative data are different from those used to collect quantitative data. Thus, the different ways of collecting quantitative and qualitative data are discussed in the following sections.

4.6.1 Qualitative Data Collection Methods

There are different forms of qualitative data collection methods. However, the most commonly used method is the in-depth interview. This method involves the interviewer asking the respondents some designed questions in relation to the research aim and objectives. This can be administered face-to-face, over the telephone, post, fax or web-based survey. The interview method of data collection has the advantage of collecting complex, subtle, in-depth facts and opinions relating to the phenomenon under study. In addition, it gives the opportunity for close interaction between the interviewer and the respondent which allows for a high level of control in the interview process (Naoum, 2007). Furthermore, Naoum (2013) added that the collection of data through interviews provides a high response rate, accurate answers, flexibility to reframe questions, and allows the researcher to seek further explanation of the issues and obtain more details particularly when it is administered face-to-face (Naoum, 2013).

Interviews can be structured, unstructured, and semi-structured. Structured interviews follow a rigid procedure with a set of predetermined questions with virtually the same wording in a tightly controlled prescribed format or order (Silverman, 2003). It is similar to a face-to-face administered questionnaire (Denscombe,2007). However, unstructured interviews are flexible and do not follow a system of predetermined questions. It is similar to a conversation regarding the research, where the interviewee needs to develop ideas and follow their

sequence of thought. On the other hand, the questions in semi-structured interviews are predetermined, but flexible in relation to the order in which they are asked and answered and this way, the interviewee can suggest ideas and discuss them widely. In line with the above intricacies, this study adopted a semi-structured interview that was administered face-to-face to potential respondents.

4.6.2 Quantitative Data Collection Methods

According to Abdulai (2007), there are different approaches for collecting quantitative data in research. These are through questionnaires, observation, documentary evidence and conducting desktop research. However, questionnaires are more widely used in conducting surveys to determine the opinions, views, beliefs and facts about the participants in a research study (Denscombe, 2007). This study also adopted the questionnaire instrument as the data collection tool that would be used to obtain information from professionals on health and safety issues in the Saudi oil and gas construction projects. Kumar (2014) confirmed that questionnaires are outstanding tools in survey research. This is mostly because they are flexible, quick to administer and relatively inexpensive to administer to a large sampled population (Denscombe, 2007).

There are several ways in which questionnaires are administered to potential respondents. These include face-to-face or self-administered questions, telephone, postal, web-based surveys, fax surveys and even interviews. The selection of which one to adopt is mostly linked to the nature of the research, the convenience for the researcher and the cost implication. In short, they all have advantages and disadvantages. Telephone or face-to-face interviews are rather expensive and may be time consuming. In the case of postal

questionnaires, these are reliable in covering a large geographical area with few financial and human resources (Bryman, 2008), however they usually require a follow-up. In addition, postal surveys could be affected by problems such as lack of control over respondents, inaccurate responses as a result of misinterpretation, and an inability to clarify when needed.

The use of fax surveys are also effective and can also be administered with less effort. However, their major disadvantage are that the respondent and the researcher must both have a fax machine to use this means. Furthermore, the fact that the respondents must print the questionnaires at their expense may affect their willingness to take part in the survey.

Web-based surveys are relatively fast, cheap and usually cover large geographical areas. But this form of questionnaire administration requires the respondents' email addresses and internet facilities. The face-to-face or self-administered survey may be time consuming and require lots of effort from the researcher. However, this approach is practical and usually more reliable than other collection methods because of the direct contact with the respondents. The advantage of this approach is that clarification could be sorted and given to the respondents, direct contact could induce a great number of respondents, the respondents are allowed to complete the questionnaire in their own privacy and comfort, it is practically inexpensive compared to most data collection methods, and a large number of responses could be collected within a short period. Therefore, the self-administered or face-to-face questionnaire survey was adopted.

4.7 Ethical Considerations

The presence of ethical policies and practices during the collection of the data items and their analysis gives considerably good result for the research study. The consideration of ethical policies gives a broader base to the research study, which further reduces the possibility of any loopholes in the research study. There are some ethical issues, which a researcher has to bear in mind at the time of conducting the research. The researcher needs to take care of the ethical requirements of the research work. An ethical approval will also be obtained from the University of Wolverhampton ethics committee before conducting the research. The ethical considerations are necessary to protect the participants, gain their confidence and trust, promote the research integrity and guard against inappropriateness (Kimmel, 2009).

In the process of securing the data, the computers that will be used through the research process will be kept under the custody of the researcher. The computers used in the process are kept under password protection and will not have permission to be used by some other person during the research process. The contents that are included in the literature review section will not be copied and pasted from various internet sources. Every line in the thesis will be written in the required language and format by the researcher. A plagiarism report will be submitted with the research work that will ensure that all the resources have been used only for reference and nothing has been copied from any other source (Axinn and Pearce, 2006).

Under other ethical consideration, the anonymous status of respondents will be maintained throughout the research process. The responses given by the respondents will not be shared with any government or non-government organisation. Potential respondents will be given a

required amount of information about the research processes and different data collection methods. The above mentioned are some ethical guidelines that were considered in advance to make the research work more viable and authentic.

4.8 Population and Sampling

A research population can be defined as a large collection of people or objects that have peculiar characteristics that are of interest to the researcher (Bless *et al.,* 2006; Kumar, 2014). Sampling involves the practical approach of choosing a few samples from a larger population to serve as the basis for the estimation, generalisation and prediction of an unknown piece of information, situation and result regarding a larger group. Consequently, sampling saves time, costs and human resources. According to Kumar (2014), there are three major classifications of sampling techniques. These are random probability, non-random probability and mixed sampling techniques (See Figure 4.2).

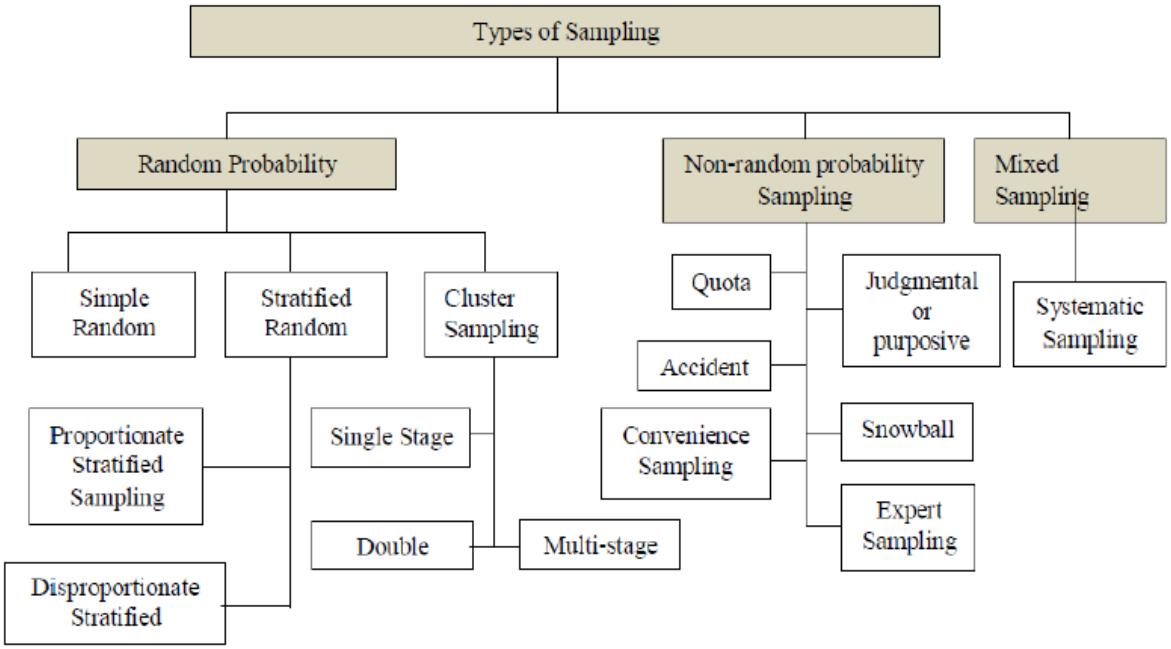

Figure 4.2: Types of Sampling Technique (Source: Ogunbiyi, 2014)

4.8.1 Random/Probability Sampling

According to Bryman (2008), random sampling is used when all the members of the population are known to the researcher even before a sample is drawn. In random probability sampling, each member or element in the study has an equal chance of being selected as a sample. This means that the choice of each member or element in the sample is not influenced by the other. This technique is divided into three, namely, simple random sampling, stratified random sampling, and cluster sampling.

4.8.1.1 Simple Random Sampling

This is a subset of a population whereby each member has an equal probability of being selected in the sample (Descombe, 2007). In this sampling technique, a researcher may put

the names of 250 employees of a company in a hat, shakes the hat and randomly picks the names of 25 employees out of the hat to act as the sample for examination. A major disadvantage of this technique is that the members selected may not be a true representation of the entire population (Biggam, 2015).

4.8.1.2 Stratified Random Sampling

Here, the population is divided into smaller groups (known as strata) based on some certain attributes and characteristic features. The relative number of the members is then drawn from each category or stratum to form the sample. This increases the chances of selecting a true representation of the population compared to the simple random sampling. A simple example is that if the people in an office are stratified based on gender into 40 males and 70 females, four males and seven females can be selected to represent the employees as a sample.

4.8.1.3 Cluster Sampling

In this type of sampling, the population is divided into identifiable groups based on certain features. These groups are called 'clusters'. To obtain a representative sample, a random selection is made from these groups or clusters (Ogunbiyi, 2012).

4.8.2 Non-Probability Sampling

In this type of sampling method, the researcher does not have a definite number of the population as opposed to the probability/random sampling method. Thus, there is zero chance of being selected as a sample. In this case, samples are chosen based on their availability and convenience to the researcher. Extreme care is required in generalising the results obtained from the samples to the population. There are various types of non-probability sampling

techniques such as convenience sampling, purposive sampling, snowball sampling, quota sampling and accidental sampling. These are discussed below:

4.8.2.1 Convenience Sampling

As the name implies, there is no special screening criterion in this sampling method, only that the data is collected from everyone available or made available by an organisation, and he or she is capable of participating in the study (Bryman, 2008). Higginbuttom (2004) simply puts Convenience Sampling as a technique of sampling aimed at participants who are readily available and easy to track or contact.

4.8.2.2 Purposive Sampling

This is also known as judgmental sampling. It is one of the most recommended sampling techniques for qualitative studies particularly using an interview approach (Bryman, 2008). The samples for this technique are chosen based on their relevance to the research question addressed. According to Descombe (2010), this sampling method is more useful when aiming to describe certain phenomenon or creating something that is not well known.

4.8.2.3 Snowball Sampling

This sampling technique is usually employed when participants are difficult to find or locate (Descombe, 2007). Snowball sampling entails finding other relevant participants through the recommendations and introduction from existing participants in order to make up the required sample size for a study.

4.8.2.4 Quota Sampling

The quota sampling technique possesses similar characteristics with the stratified sampling technique. In this technique, the researcher pre-decides that needs certain percentages (or numbers) and characteristics of a sample. Then searches for enough participants until he /she satisfies the pre-defined criteria. For example, a researcher may decide that he/she require 40 primary school teachers, 20 secondary teachers and 50 university lecturers. He/she therefore does not relent or continue with the analysis until he/she gathers the aforementioned number of data.

4.8.2.5 Accidental Sampling

This technique is more common among newspaper reporters and brokers. It is usually based on convenience in getting access to the sample population. This type of technique has to do with the researcher setting a target number for the sample. When the required number of respondents are reached, the data collection stops immediately.

4.8.3 Mixed Method Sampling/Systematic Sampling

This is a type of sampling technique where every n_{th} member of the population is chosen to form the sample (Descombe, 2007). The researcher first makes an organised list of all the members of the population. In this sampling method, the size of the sample to be identified and the total number of members helps to determine the number of populations to be skipped. For instance, if ten samples are to be chosen from a population of 100 members, every 1st to 9_{th} members are skipped i.e. every 10_{th} member will be selected. The important thing to note in this method is that the first member, usually called the 'starting point,' is selected randomly.

4.9 The Qualitative Study

This section of the research presents information on the design of the qualitative phase of the research. The section discusses the sampling method adopted for the study, the population from which the samples are taken and the research instrument.

4.9.1 Sampling Technique Adopted

This research focuses on the development of a strategic model for health and safety management in the Saudi oil and gas construction projects. Thus, the best sampled population required to participate in this study must be familiar with what health and safety management entails and even contribute on how to ameliorate or enforce it to prevent the prevalence of accidents on sites. Hence, the major criteria for selecting the samples were based on the location of the company (i.e. operating in Saudi), the size of the company (i.e. large, medium and small sized), and the position held in the company's organisational structure (i.e. upper, middle and lower management). This was an attempt to collect a wide range of reliable data from different perspectives or angles, and also bridge the gap for any surprises. After a careful review of all the aforementioned sampling techniques, purposive non-probability sampling was deemed more suitable for the study, because the total number of professionals with the above specified criterion is near impossible to obtain. Therefore, samples of professionals and stakeholders in the oil and gas construction projects were selected based on relevance to the question addressed in the study. Furthermore, purposive sampling is among the most recommended sampling techniques for qualitative studies particularly interviews, and fortunately this study uses qualitative interview methods. A list of different oil and gas companies with their different sizes was obtained from the Saudi Arabian oil and gas

companies. 15 companies of different sizes were contacted to participate in the exploratory study (see appendix for invitation letter). However, only nine organisations honoured the invitation, and each was represented by one person to participate in the semi-structured interview. Health and safety is regarded as a delicate and very sensitive subject particularly in a place like Saudi Arabia. Thus, a lot of companies avoided participating in the H&S research.

4.9.2 The Interview Design

An interview can be described as a conversation between two or more people on a certain topic where the interviewer asks certain questions to the interviewee to provide his views. It is generally a formal meeting where one or more people address questions to another person (Kothari, 2004). It is usually done to generate information about a particular phenomenon. Interviews are useful to generate detailed information about one's personal feelings, perceptions and opinions (Panneerselvam, 2004).

The interviews were designed according to published best practice as suggested by Bryman (2008). Thus, the semi-structured interview is separated into three sections:

Section A solicits personal information on the interview participants. This involves questions on the respondents' years of experience, position in the organisational structure and role played regarding the safety of projects.

Section B Focuses on the health and safety measures employed in the oil and gas construction company, coupled with questions on the reasons and importance of undertaking health and safety measures.

Section C Requests information on the effectiveness of health and safety measures in preventing the occurrence of accidents on construction sites. In this section, the interviewees were asked for suggestions on how to ameliorate health and safety measures applied, and the benefits they acquired by applying them.

With all this being explained, it is important to note that follow up questions were addressed during the course of the interview to obtain clarity and outsource important suggestions.

4.10 The Quantitative Study

4.10.1 Sampling Technique Adopted

The target population for the quantitative survey consisted of professionals and personnel working in the Saudi oil and gas construction projects. These populations were randomly sampled because of their close involvement in oil and gas related construction activities and therefore their opinion on health and safety matters will be relevant in making informed decisions. A simple random sampling technique was adopted in sharing the questionnaires.

A total number of 300 questionnaires were distributed to personnel working in 15 oil and gas companies operating in Saudi Arabia. However, only 200 questionnaires were recuperated as valid responses.

4.10.2 Questionnaire Design

A questionnaire is a data collecting instrument were a series of questions are written to gather information from the respondents. These were designed in such a way so as to derive the exact information from the respondent's side (Goddard and Melville, 2004). It is helpful in collecting the appropriate information that is useful to get a proper analysis of the

phenomenon. It helps in gathering large amounts of accurate information collected from many of people in a short time (Kothari, 2004). Consequently, the results of the questionnaire are quickly and easily quantifiable by the researcher (Goddard and Melville, 2004).

The proper design of the questionnaire is a vital part in a research study because it significantly influences the outcome of the research (Naoum, 2013). The questionnaire was designed to consider several issues related to health and safety as discussed in the literature and particularly factors enumerated in the aim and objectives. There are two types of questionnaires, namely structured and unstructured questionnaires.

A structured questionnaire was designed with a series of close-ended questions in which respondents were given a choice of alternative answers to rank their opinions in order of preference or importance (Naoum, 2007). The rationale for the choice of such questioning was because of the advantage of having a clear comparison of responses across groups or individual respondents (Denscombe, 2007). Furthermore, close-ended questionnaires require less time to complete and decode when compared with open-ended questionnaires. Bryman (2008) confirmed this statement when he opined that close-ended questions are easier to ask and analysed as compared to open-ended questions that allow the respondents to provide free responses without any choice.

The questionnaires were also designed using the Likert scale to measure the opinions of personnel working in the oil and gas construction projects. Jamieson (2004) attested that Likert scales are best suited when seeking to measure opinions, behaviours, beliefs and items. The advantage of adopting the Likert scale is that it informed the researcher's decisions.

Based on the pilot study (discussed subsequently) the questionnaire covered two main sections.

Section A Solicits information or details of the respondents and their company. The section contained eight questions, including the designation in the organisation, years of work experience, the number of employees in the organisation, the type of work they do, the category of construction firm they work for and the type of oil and gas construction projects they undertake.

Section B Focused on health and safety policies during oil and gas construction projects. The questions also covered the areas of government intervention such as legislation, training for health and safety, the measures adopted specifically for oil and gas construction projects, the benefits of such measures and the barriers to achieving such benefits. There were also questions on the level of education needed to achieve health and safety training on oil and gas construction projects. To test the data collection instrument, a pilot study was conducted prior to full roll out.

4.10.3 Pilot Study

To ensure the data collection process led to the gathering of very reliable results and free from technicalities, a pilot data collection was organised. The pilot study (as discussed in Thabane et al., 2010) guided the development of a good, effective questionnaire survey for the research. The process also helped to identify potential issues with the research instruments. For this research, the pilot study was conducted prior to the distribution of the questionnaire to the potential respondents with the aim of testing and ensuring the reliability of the research instrument, as well as the fitness of the questionnaire for the purposes of this

research. A total of 50 questionnaires were sent to respondents out of which 36 were received as valid. The relative high response rate was partly due to the follow-up calls made by the researcher, and the fact that many of the respondents were presently involved in academic research. During the pilot study, significant contributions were made by university students and other PhD colleagues in the form of advice to remove inconsistencies, ambiguous questions, misguided questions and also provocative questions.

The comments from the questionnaire survey suggested that there were too many questions, a total of 53 questions - and this proved to be too much for the respondents. On the average it took the respondents about 45 minutes to answer the questions due to the wording. This proved to be difficult for the respondents and was going to lead to poor responses during the main survey.

Apart from completing the wordings in the questionnaire, the participants were asked to give recommendations on the questionnaires structure (including clarity, layout, and friendliness) and the time it took to fill out the questionnaire. As suggested by Xiao (2002), a follow-up interview was undertaken with three PhD students in construction management and a PhD supervisor. Feedback from the supervisor was greatly appreciated as it helped in better organising and redesigning the questionnaire. Based on the outcome of the pilot study, the research instruments were redesigned to ensure the questions were directed at the aim and objectives of the research. This ensured the questions were comparable to the issues identified in the development of the conceptual framework. Taking on board the feedback from the pilot study, the questions were reviewed to address concerns raised. The majority of the questions were then grouped together into tables with the help of a Likert scale to

reduce the burden on the respondents while maintaining the key questions required for the research. After reviewing the instrument, a total of 22 questions were retained. These questions covered key areas such as:

- Health and safety knowledge of respondents;
- Extent of development of health and safety policies relevant to oil and gas construction projects;
- Effectiveness of health and safety policies and measures;
- Barriers to achieving health and safety on oil and gas construction projects;
- Education on health and safety issues.

When the questions were fully set up it took only 20 minutes to completely answer the questions, and the structure of the questionnaires were generally found to be attractive.

A test for validity and reliability was also undertaken as part of the pilot study in order to determine the credibility of the research and also to validate the findings.

4.11 Data Analysis

After the data collection, an analysis process began with the aim of appreciating important patterns that relate to the aim and objectives of the research, leading to the overall research outcome (Kumar, 2014). The selection of the data analysis approach is important for the development of a good research study. The collection and analysis of critical data collected from participants needed to be properly presented through specific methods particular to the type of research method. Considering that both qualitative and quantitative data was collected for this research, the data analysis process also adopted both quantitative and qualitative

approaches. As discussed in Bryman (2006) and in Creswell and Clark (2007), the use of both qualitative and quantitative data analysis in a single study can lead to triangulation and completeness of the results which allows for the corroboration of evidence from the qualitative and quantitative phases and provides a complete picture for the study.

4.11.1 Qualitative Data Analysis Method Adopted- Thematic Analysis

Yin (2013) and Creswell (2013) report that qualitative data analysis focuses on going beyond the surface of the data to interpret the results from the viewpoint of the participants. For qualitative data, the process involves the coding of the raw data, the presentation of the data, analysing the data and interpreting the results. For the sake of qualitative data in this study, a thematic data analysis method was adopted. This method involves identifying, analysing and reporting patterns or themes within a data set in order to enable a rich description of the data and also interpret various aspects of the research topic. Despite the wide use of thematic analysis for qualitative methods, there is no consensually standardised definition for undertaking it (Attide-Stirling 2001; Boyatzis 1998; Tuckett 2005; Bashir, 2013). Nevertheless, Boyatzis (1998) defined thematic analysis as a process of encoding qualitative methods by categorising the results from the data obtained into themes and patterns to show similarities of views across the participants. These themes are units obtained from patterns such as topics of conversation, recurring activities, feelings, vocabulary etc. (Arson, 1994).

According to Braun and Clarke (2006) a theme captures important issues about the data in relation to what is being researched. It also represents some level of advanced response or meaning within a set of data. Themes or patterns in thematic analysis are identified in one or two primary ways which are inductive and theoretical approaches. In an inductive approach,

the themes are strongly related to the data themselves, which means that they bear little relationship to the questions addressed to the research participants. In detail, “inductive thematic analysis is a process of coding data without trying to fit it into a pre-existing coding frame, or the researcher's analytic preconceptions” (Braun and Clarke, 2006, p. 12). This form of thematic analysis is data driven. However, theoretical thematic analysis is analyst-driven in the sense that it is driven by the researchers' theoretical or analytic interest in the area. This category of thematic analysis provides more detailed analysis on the aspect of the data than the description of the overall data. The choice between which approach to use depends on how and why the researcher is coding data. For instance, when a researcher codes for a specific research question looking to understand a specific phenomenon related to the research question, then he/she is applying a theoretical thematic approach.

However, when the research question evolves through the coding process, the inductive approach is applied. In line with the above explanation, the theoretical thematic analysis was used to code the data in the study since the researcher has a preconception of what aims to be analysed (i.e. the effectiveness and viability of health and safety measures in the Saudi oil and gas construction projects).

There are six phases or guidelines for thematic analysis which are explained below:

4.11.1.1 Phase 1: Becoming Familiar with the Data

The first phase of the qualitative data analysis process is to understand the data gathered through the interview. During this phase, the researcher is deeply immersed in the data to the extent that she became familiar with the entire data collected. This was achieved through “listening to the data repeatedly” in an active manner while searching for patterns, meanings

and so on. This helped the researcher to paint a good picture of the interviews conducted. As part of this, the researcher took notes and marked ideas for the coding process.

4.11.1.2 Phase 2: Transcription of Verbal Data

This is regarded as a key phase to aid data analysis interpretation and is also an excellent way to become familiar with the obtained data. In the case of the interview which was recorded using an android app, the interview was continuously listened to and transcribed into written form to enable the thematic analysis. There are various methods involved in transforming spoken text into written texts. Similarly, some systems of transcriptions are even developed for specific forms of analysis such as the Jefferson system. However, thematic analysis does not need such a complex level of transcription, and there is no one single method for such. The important thing that was considered by the researcher during the transcription was that the information needed from the verbal account was true to its original form and nature (Poland, 2002). This led to the transcription of the interview audio files into text to make it easy to code and make meaning from the views of the respondents.

4.11.1.3 Phase 3: Identification of Meaningful Patterns and Issues

At this stage, the researcher repeatedly read the transcribed data to identify meaningful patterns and issues that are of potential interest to the researcher. Through this course, phrases, segments and key words related to the research aim and objectives were identified and formed the basic drafts before the coding process. This helped the researcher to have a better understanding of the data and to identify the linkages between the interviews and the aim and objectives of this research. By doing this, the research was able to plan for the key aspects of the interview transcripts used for the research.

4.11.1.4 Phase 4: Generating Initial Codes

After becoming familiar with the interview transcripts, this research proceeded to code the interview transcripts. As presented in Sgier (2012) and Liamputtong (2009), coding is an aspect of qualitative data analysis which involves organising and making sense of the contextual data. Coding is an integral part of thematic qualitative analysis which helps to organise data into meaningful categories and segments. Therefore, what the researcher did in this phase was to assign codes to the extracts such as segments, phrases and segments. This coding exercise was done with the help of the qualitative data analysis software, QSR NVivo. This helped to ensure that no relevant aspect of the data was left untouched. From the initial coding process, a total of 250 codes were generated from the data. These codes represented chunks and paragraphs of the data and the abstractions made from them.

From further analysis and reviewing of the codes, a total of 80 categories were generated from the codes. Known as parent nodes in NVivo, these categories were based on some of the key areas captured in the development of the conceptual framework. Other categories were formed from putting together codes with similar meanings or covering similar subjects. The list of categories generated from the coding process is presented in the Table 4.4.

Table 4.4: The list of categories generated from the coding process.

1. Health and safety policy	2. Safety training	3. Help and safety measures
4. Importance of health and safety measures	5. Oil and gas health and safety	6. Construction health and safety
7. Environmental impacts	8. Client satisfaction	9. Company size and health and safety
10. Health and safety planning	11. Health and safety implementation	12. Health and safety monitoring
13. Roles of employees and workers	14. Health and safety risks	15. Productivity
16. Government intervention	17. Compliance with health and safety	18. Health and safety precautions
19. Barriers to achieving health and safety	20. Health and safety promotions	21. Health and safety bulletins
22. Advantages of health and safety measures	23. Cooperation with government agencies	24. Personal protective equipment
25. Effective health and safety programmes	26. Participation of site teams in safety planning	27. Risk management plans
28. Risk register for projects	29. Level of awareness	30. Motivation to embark on safety measures
31. Construction safety	32. Occupational hazard	33. Improvement in health and safety measures
34. Preplanning for health and safety issues	35. Health and safety seminars	36. Use of health and safety professionals
37. Exposure to health and safety risks	38. Occupational health and safety legislation	39. Occupational health and safety issues
40. Division of occupational medicine	41. Demonstrating effectiveness of health and safety measures	42. Environmental impact assessment
43. Priority for health and safety management	44. Basic health and safety measures	45. Commitment to health and safety measures
46. Integration between managers and employees	47. Increase in health and safety incidents on site	48. Periodic monitoring
49. Regular maintenance	50. Emergency response measures	

These categories were taken to the next stage of the research which focused on creating the themes forming the basis for this research.

4.11.1.5 Phase 5: Defining and Naming of Themes

During the development of the themes, the researcher defined and refined the categories to form the themes for this research. This simply means identifying the significance of what each theme is all about and what part of the data each theme captures. According to Anderson (2007); and Creswell (2013), this phase is particularly useful as it aides re-evaluating the collated extracts under each theme in order to confirm it gives the correct picture of what the themes are. Through a process or encoding and decoding, the categories were refined and consolidated to form the key themes and sub-themes of the research. The themes identified through the process form the basis for presenting the results of the qualitative phase of the research. From this process, three main themes were developed from the research. These themes are:

1. Importance and benefits of applying health and safety measures;
2. Health and safety measures specific to oil and gas construction projects;
3. Effectiveness of implementing health and safety measures.

From the building of the themes, sub themes were also developed to help in the presentation of the results. In all eight sub-themes were developed for this research.

4.11.1.6 Phase 6: Producing the Report

This phase involves interpreting, describing and illustrating the results across the different themes using extracts and quotations from the original data. Thus, the researcher reported the

findings in a concise, logical and coherent manner while relating to the literature review to show similarities of opinions and knowledge that could be used to improve the framework in this study. As part of the report, tables were used to simplify and present results for easy comprehension.

4.11.2 Quantitative Data Analysis

The statistical package for social sciences software, SPSS, was used as the tool to aid the quantitative data analysis for this research. Statistical data analysis for the responses from the questionnaire survey focused on descriptive and inferential statistics. This helped to answer the questions posed by this research.

4.11.2.1 Descriptive Statistical Analysis

Descriptive analysis helps to develop clarity and understanding of the data collected for research. This is possible through providing a summary description of the units of analysis in a sample. According to Denscombe (2007), one of the advantages of descriptive statistics is its ability to show patterns and processes in the sampled data. There are several types of descriptive statistical tools; and the choice of which one to adopt largely depends on the nature of the data obtained or variables involved. For instance, the variables in this study's questionnaire are 'univariate'. This means that frequency distribution as a form of descriptive statistical tools can be employed (De Vaus, 2002) to show the frequency of occurrence for each variable in a set of scores. In brief, this is able to measure the distribution of respondents' scores either as a whole number or percentage across each scale level (Denscombe, 2007). This was largely used in the study to rank the impact of the health and safety policy,

awareness of and effectiveness of policies, practices, and areas affected by ineffective H&S management.

4.11.2.2 Inferential Statistical Analysis

To ensure the data analysis process for the quantitative data led to reliable and meaningful outcomes, various inferential statistics were undertaken to determine the significance of the relationships identified including cross tabulations, chi square tests and correlations. For the correlation tests, Spearman's correlation was deemed more appropriate for this research due to the nature of the data gathered.

There are two types of Chi-square test - the independency test and the goodness of fit test, also known as the One sample Chi-square test. The former is used to test whether there is an association or link between two set of variables (bivariate) (Denscombe 2010). While the latter is used in univariate data to justify whether the sample is a representation of the population, this is ascertained when the differences between the expected and observed frequencies are significant (De Vaus, 2002). Since the data in the study are univariate, the researcher adopted the goodness of fit test. In an attempt to further explain the one sample Chi-square test, De Vaus (2002) tested whether the distribution or responses were similar or different across the categories or variables by comparing the set of observed and expected data. One sample chi-square begins with assuming that the views of population are equally distributed across the response categories in each variable. Thus, when the p value is less than 0.05, the null hypothesis can be rejected, that is to say that the results are statistically significant. In this study, a variable with three or more categories could be tested to ascertain whether the differences between the percentages across the categories were as a result of

error due to sampling or whether it reflected the real percentage difference in the population (De Vaus, 2002). The null hypothesis is therefore described as follows:

H_0: The percentages of all categories of each variable are equal to the specified population.

To help with the formulation of ideas for the chi square test, cross tabulations were run based on the variables of the research. Based on the results of the cross tabulations, Pearson Chi square tests were used to determine the significance of the relationships identified. These cross tabulations, correlations and chi square tests were used to determine and help identify the interrelationships among the different variables and to help identify and form a better picture of the health and safety issues in the oil and gas construction projects in Saudi Arabia.

4.12 Reliability and Validity Checks

This is an essential process for establishing confidence in the results obtained and conclusions presented. To achieve reliability in this study, the transcribed data were read several times to ensure that they were free from any mistakes or omissions that could jeopardise the outcomes. In addition to this, the codes were cross-checked over and over to make sure that the codes were representations of every collected theme, word or phrase. As for the validity check, the researcher ensured that the themes were established in relation to the research question, aim and objectives of the study. In order to further check the process validity of the participants to the research, they were allowed to comment on the findings from the research. The details of this process was discussed in Chapter 7.

4.13 Summary of Chapter Four

The use of an efficient research methodology supports the development of an accurate research study. This chapter presented the research approach, the research design and the research strategy necessary for the realisation of the research aim and objectives. It basically explained the various philosophical worldview or paradigms known as positivism and interpretivism and how they affected the mode of enquiry in social research. Under the aforementioned paradigms, the chapter explained the qualitative and quantitative research methods together with the implications for adopting each one. After thorough examination, both of them were selected as the research methods for the study. This pragmatic approach meant that there were different data collection methods and instruments and different sampling techniques and analytical methods.

For the qualitative method, a semi-structured interview was used to gather data necessary for the development of a model for health and safety management in Saudi Arabian oil and gas construction projects. The data entailed descriptions, explanations, narratives of experience and feelings and opinions of professionals on how to ameliorate health and safety. The data obtained were coded and analysed using thematic analysis. As for the quantitative method, a structured questionnaire was used with a series of close-ended questions to determine various factors such as the impact of health and safety policies, awareness of health and safety policies and the effectiveness of health and safety policies and practices among others.

The data obtained were analysed using descriptive statistical tools such as frequency distribution and inferential statistics, in particular, the one sample chi-square test. However, these were calculated using the Statistical Package for the Social Sciences (SPSS). Finally,

the procedure employed to obtain permission from the University's ethics committee was explained in this chapter.

CHAPTER FIVE: QUALITATIVE DATA ANALYSIS AND DISCUSSIONS

5.1 Introduction to Chapter Five

The objective of this research is to develop a framework that can help construction health and safety managers to focus their priorities on factors that will reduce accidents on construction sites. The chapter achieves this by analysing and discussing the qualitative data obtained from the research participants through the interview process. The chapter specifically focuses on the following themes: the effectiveness of health and safety measures employed in Saudi oil and gas construction projects, the roles played by professionals in preventing accidents on site and the necessary health and safety measures to be employed in preventing exposure to health and safety risk. The chapter is divided into seven main sections: the process adopted in analysing the data including the building of themes, the demographics of the interviewees, planning for occupational health and safety, health and safety measures, the effectiveness of health and safety measures, the importance of health and safety measures and the barriers to achieving health and safety on construction sites.

5.2 Data Collection and Analysis

This study employed a qualitative approach while using a semi-structured interview to elicit data from nine professionals working in the Saudi oil and gas construction sector. The criteria for the selection of the interview participants were based on the position of the respondents in the organisational structure, the years of experience and the size of company. Since the

research entails developing a model for health and safety management in Saudi Arabian oil and gas construction projects, there was a need for participant input in the form of descriptions and elaborations.

Thus, some degree of flexibility would be required in the form of follow up questions to obtain in-depth information, and the best way to acquire this flexibility was through a semi-structured interview. The 35-minute interviews were recorded using a phone recorder app and were later transcribed word for word in order to organise and prepare the data for analysis. The transcribed copy was read several times to have a good understanding of the general ideas and identify important suggestions related to the aim and objectives of the study (Creswell 2006, Flick 2009).

The data obtained from the interviews were analysed using a thematic analysis method. This method is particularly suitable when aiming to obtain rich and detailed meaning from an interview (Braun and Clarke, 2006). The method provides the researcher with the opportunity to obtain information from respondents and categorise them into themes and patterns to show similarities of views across the participants. To facilitate the analysis of the data, words, phrases and segments from the interview were systematically coded and categorised into themes. These themes were then further analysed to obtain patterns or relationships among the set of data which was then reported accordingly.

The different themes that were identified from the interview were: the importance and benefits of implementing health and safety; its effectiveness in each respondent's organisation; health and safety measures and the roles of respondents in preventing accidents

on construction projects. Details of the analytical process are presented in the methodology chapter.

5.3 Demographics of Interviewees

A total of nine professionals working on the construction projects were interviewed for this research. These personnel are knowledgeable and familiar with health and safety on construction sites and this formed the basis for the purposeful selection of the participants. A general overview of the interviewees is presented in Table 5.1.

Table 5.1: Demographic information on interviewees

Respondents	ROLE	Work experience in years	Size of organisation	Level of management/position
R1	Environmental Health and Safety General Manager	10	Large-sized	Upper level
R2	Environmental Health and Safety Inspector	7	Large-sized	Middle level
R3	Maintenance and Monitoring Inspector	5	Large-sized	Lower level
R4	Assistant General Manager	12	Medium-sized	Upper level
R5	Marketing Manager	5	Medium-sized	Middle level
R6	Operations Operator	3	Medium-sized	Lower level
R7	Executive Manager	9	Small-sized	Upper level
R8	Maintenance Manager	3	Small-sized	Middle level
R9	Health and Safety Supervisor	1	Small-sized	Lower level

According to Table 5.1, the respondents for this research worked at different levels and sizes of companies and had different roles. Notably among the job roles were health and safety managers who were in charge of developing policies for the companies.

The personnel involved in the interviews were: Environmental Health and Safety Managers (R1), Environmental Health and Safety Inspectors (R2), Maintenance and Monitoring Inspectors (R3), Assistant General Managers (R4), Marketing Managers (R5), Operations Operators (R6), Executive Managers (R7), Maintenance Managers (R8) and Health and Safety Supervisors (R9).

5.3.1 Interviewees'/Organisations' Size and Status

The oil and gas construction sector in Saudi Arabia comprises a wide variety of companies of different sizes and status, which are categorised into large-sized, medium-sized and small-sized companies. These classifications are based on the number of employees, the annual turnover and the company assets. According to Table 5.1, R1, R2 and R3 work mainly in large-sized companies, all of which operate mainly in Saudi Arabia, with subsidiaries across the globe. Each of these companies has a global work force of no fewer than 25,000 workers. R4, R5 and R6 work in medium-sized companies with no fewer than 1,000 employees worldwide, while R7, R8, and R9 are employed in small-sized oil and gas companies that are solely based in the Kingdom of Saudi Arabia with a workforce not lower than 50 employees. From these results it is apparent that the interviewees are all directly involved with significant work forces and can therefore provide reliable information on health and safety related issues and practices.

5.3.2 Level/Position of Interviewees' in their Organisation Structure

Interviewees in this study, R1, R2, and R3 are all positioned at the upper level in the management structure. Thus, they are directly involved in the overall decision-making process of the company. This means that their opinions will matter significantly in relation to the measures, procedures and implementation of safety and health related decisions. Iinterviewees at the middle-level of the management structure were R4, R5, and R6, while the rest of the interviewees (R7, R8, and R9) were positioned at the lower-level in their company's management (Table 5.1).

The distribution of the interviewees in this study was strategic because all relevant information associated with the safety and healthcare of the workers from the top to bottom of the company hierarchy could be outsourced in order to reach reliable, sufficient and informed decisions.

5.3.3 Work Experience

The level of work experience across the interviewees was different (Table 5.1 above). R1, R4 and R7 had 10, 12 and nine years of work experience respectively, while R2 had only seven years of experience working in the oil and gas construction sector. Furthermore, both R3 and R5 had five years of working experience, whereas R6 and R8 had three years of experience. R9 was the least experienced of the interviewees and happens to work in a small-sized company at the bottom-level of his company's management. On the other hand, R5, the most experienced among the interviewees, worked in a medium scale company at the middle level of the company's organisational hierarchy structure. All the interviewees had an average of six years of working experience, which meant they were in a good position to

discuss the impact of health and safety practices and even give suggestions as to a way forward.

5.4 Health and Safety Management on Oil and Gas Construction Companies

This section of the research presents the results of the themes developed for the data analysed. This is presented based on three main themes: the effectiveness of health and safety measures employed in the Saudi oil and gas construction industry, the roles played by professionals in preventing accidents on site and the necessary measures employed to prevent exposure to risks from accidents.

5.5 Planning for Occupational Health and Safety Risks on Sites

One of the key themes from the qualitative phase of the data collection process was to identify the basis for planning against exposure to accidents at oil and gas construction sites. This section of the analysis focuses on identifying the basis for planning occupational health and safety measures adopted in the construction companies. From the results, it was identified that all the companies had different systems in place for planning against health and safety risks. A common theme among all research participants was the planning and monitoring of the health and safety implementation on oil and construction project sites.

As many as seven out of the nine research participants (R1, R2, R3, R5, R6, R7, R9) indicated that the key part of health and safety management in their companies was the planning and monitoring of the implementation of the various measures they set in place. As identified from the research, planning was necessary to ensure that important aspects were taken into

account whereas monitoring was put in place to ensure the plans achieved the desired outcomes.

Planning encompasses both preventive and corrective measures, while monitoring keeps note of whether the plan had been implemented, how it has been implemented and the results or outcome from the implementation. According to R6, *"effective plans and careful implementation of risk management techniques by workers proves the merit of risk management and the cooperation of employees at the workplace, which in turn raises the level of occupational health and safety in the organisation and reduces safety risks to the minimum level."*

In an attempt to further identify the effectiveness of planning, some interviewees (R3, R6 and, R9) were asked to elaborate the benefits of proactive planning. R9 stated that this kind of planning *"raises the level of occupational health and safety measures taken by employees and workers, and this is reflected in the quality of operations, raising the productivity and the level of harmony between the competing companies."* This statement was backed by both R3 and R6 who stated the benefits of proactive planning as reducing accidents and costs resulting from any incidents, avoiding delays and thus saving time for the company, raises productivity and the reputation of the company and provides satisfaction to clients.

A key aspect of planning for health and safety was the involvement of key site staff as participants in the planning process. Interviewees R6 and R7 believe that they participate in all necessary measures relating to health and safety at the workplace. According to R7, *"my organisation holds periodic meetings to discuss health and safety issues between all managers and the staff under their command."* In the literature, health and safety meetings

during construction projects are also emphasised as an important avenue for enlightening and cautioning employees on the dangers of neglecting safety measures (Bashir 2013).

Interviewees R2, R4, R6, R7 and R9 agreed that monitoring and improving the level of awareness concerning occupational H&S measures was crucial in preventing the occurrence of accidents on site. R9 confirmed that *"the most important thing was the awareness and understanding of employees concerning risk management tasks. They should be aware of the necessary actions to be taken in case of danger or emergency and what they should do to raise their productivity*."

Likewise, Olutuase (2014) adds that absence of a medium, where employees or workers could make suggestions on safety, is a major contributory factor to accidents on site. From these results, it is clear that the majority of the respondents' organisations in this study employ H&S measures in one way or another. However, Berger (2008) reveals that in spite of the safety measures adopted by the Kingdom of Saudi Arabia, its management in the oil and gas construction sector was still not up to standard as there were no specific rules, policies and guidelines to maintain it. As a result, accidents were still having devastating effects on the oil and gas construction sector. That is why this study has proposed to develop a model that will consider the country-specific health and safety issues which are combined with published best practices from various literature sources.

5.6 Health and Safety Measures at Oil and Gas Construction Projects

From the outcome of the analysis, a key theme that emerged from this research were the different measures adopted by these organisations to improve health and safety on their construction project sites. It was identified through the data analysis process that the

measures adopted were similar throughout the different companies although the extent to which such measures were used differed. The common measures adopted to improve health and safety are presented in Table 5.2. The different measures adopted to improve or achieve health and safety in the different companies were grouped into 10 categories including: plan and monitor health and safety implementation; monitor and improve the level of awareness concerning occupational H&S measures; periodic investigation of any hazards or malfunction in machinery and equipment (risk assessment); commitment by employees and workers to health and safety programmes; updates of H&S programmes; proper collaboration between employees and H&S management; attend seminars relating to H&S; cooperation with governmental organisations in maintaining safety for employees and workers; provision of adequate Personal Protective Equipment (PPE) for employees and the participation of staff in determining the rules or programmes relating to H&S.

One of the key measures adopted to achieve health and safety measures on oil and gas construction projects were education and training programmes for staff of the construction companies. All the interviewees' organisations, except interviewee 8, described education as one of the key means of preventing occupational health and safety accidents on site. According to respondents 1, 2, 3 ,5, 6, and 9, this was achieved in their respective companies by organising seminars and training with the aim of raising awareness on safety issues and ensuring that health and safety measures were strictly applied in the workplace. As a Health and Safety Supervisor, R9 explained enthusiastically that *"the seminars and training on health and safety measures organised by our company are definitely making things easier*

for me because I don't have to keep on repeating and explaining to workers the importance of using safety measures."

According to R1, offering seminars and training courses for employees is an effective way to raise awareness and provide experience to workers. In addition, R2 was asked "what is the main factor to be considered by his company while undertaking health and safety measures". He specifically suggested *"improving the level of awareness concerning H&S measures and monitoring the application for this."* Pungvongsanuraks and Chinda (2010) similarly stated that creating awareness of safety and implementing it was an important H&S measure. In Saudi Arabia, the Ministry of Labour is generally involved with the inspection of sites and spreading awareness among workers about the occupational health and safety programmes. Nonetheless, an in-house department should be created to enlighten employees on the importance of safety and of the adherence to its procedures. In response to the question asked, R1 stated that *"in our organisation, effective health and safety programmes are created and monitored by a division of Occupational Medicine which helps to prevent any injuries and infections and boosts the general health and safety of personnel across the organisation."* He explained that this division was composed of professional medical consultants, health and safety experts, and specialists to test employees' hearing and vision periodically. This means that R1's organisation employs consultants to take care of health and safety issues that may arise. This sort of arrangement is also discussed in the literature by the Health and Safety Executive (2015).

Table 5.2: Measures adopted for managing health and safety on oil and gas construction projects.

S/No	H&S Measures	Number of interviewees suggesting these measures	Interviewees
1	Planning and monitoring H&S implementation	7	R1, R2, R3, R5, R6, R7, R9
2	Monitoring and improving the level of awareness concerning occupational H&S measures	5	R2, R4, R6, R7, R9
3	Periodic investigation of any hazards or malfunction in machinery and equipment (risk assessment)	5	R2, R4, R5, R6, R7
4	Commitment by employees and workers to health and safety programmes	4	R3, R4, R7, R9
5	Keeping in touch with the latest updates concerning H&S programmes	4	R1, R2, R4, R7
6	Proper collaboration between employees and H&S management	3	R2, R8, R5
7	Attending seminars relating to H&S	3	R1, R5, R9
8	Cooperation with governmental organisations in maintaining safety for employees and workers	2	R2, R6
9	Provision of adequate PPE for employees	2	R2, R4
10	Participating of staff in determining the rules or programmes relating to H&S	2	R1, R7

It is stipulated there that hiring health and safety consultants is not profitable for either medium or small sized companies because of the huge financial implication and the fact that the companies would not inculcate health and safety principles in their business.

According to Table 5.2, it can be seen that the majority of the interviewees (R1, R2, R3, R5, R6, R7, R9) identified planning and monitoring of H&S implementation as the most important measures to prevent the occurrence of accidents on construction sites. This was confirmed by Suraji et al. (2001). The periodic investigation of any hazards or malfunction in machinery and equipment (risk assessment) was also advocated by five interviewees (R2, R4, R5, R6, R7) as an important H&S measure. This was deemed very important as many health and safety issues on oil and gas construction sites was as a result of faulty machinery or equipment. As an assistant manager in a medium sized company, interviewee R4 stated that *"periodic supervision and regular maintenance of machinery is a way forward in preventing accidents on site."* Similarly, R7 suggested that *"the performance of machines should be monitored and maintenance carried out on a regular basis."* This measure is also a proactive approach to accident prevention usually cited in the literature. To further accentuate the effectiveness of risk assessment, R3, R6, and R9 were asked about what aspect of a risk assessment framework could be applied to determine prospective risks at workplace. R3 and R6 both stated that the risk assessment framework should include developing appropriate plans according to the extent or size of the threats, and supervising and monitoring workers in terms of compliance with appropriate regulations relating to protective clothing and any prospective threats. R3 further suggested periodic monitoring of machinery

and maintenance, providing indicative plans for necessary instructions for workers and using phosphoric lights in the workplace.

On the other hand, R9 suggested the inclusion of risk-protective precautions, such as warning bells as part of a risk assessment framework, to determine prospective risks.

As mentioned earlier, another very important measure adopted to ensure health and safety management was the commitment to relevant programmes on the part of the employees and workers of the organisation. R3, R4, R7, and R9 agreed that commitment to health and safety programmes by employees and workers was an important approach to accident prevention, saying that "*Without commitment to a course, all efforts become void."* Thus, R4 considered that *"employees should be committed to all necessary precautions in order to have a safe working environment."* In the literature, Alasamri, Chrisp and Bowles (2012) confirmed that an effective safety management system requires strong commitment, proper leadership, alignment with rules and regulations and involvement of the management in the safety of its workers. An increase in the occurrence of accidents at work sites logically reduced the level of commitment and loyalty towards the organisation. Thus, this phenomenon is worth looking out for. Different measures were taken by the construction companies to improve employee commitment to health and safety measures. To ensure commitment, the respondents indicated that their respective companies adopted increased training coupled with a reduction in the number accidents on site as a means to give the workers the confidence in the measures adopted by the company. This helped the workers to clearly experience the importance of the training and education they received on health and safety as well as the need to properly undertake their activities.

Four of the respondents (R3, R4, R7 and R9) suggested that keeping in touch with the latest updates concerning H&S programmes should be regarded as a significant approach to solving health and safety issues. It is often said that information is power, and thus being well informed and having up-to-date knowledge of health and safety features that include innovative Personal Protective Equipment PPEs, machines and procedures were relevant to accident prevention in the oil and gas construction sector. R4 suggested that *"brochures about the latest health and safety measures should be provided to raise awareness among workers on safety issues."*

Proper collaboration between employees and management is another important measure that needs to be considered (R2, R8, R5). When R2 was asked his opinion on whether there was a need for proper integration between employees and management in an organisation regarding safety, he stated that *"integration is very important in order to avoid any gaps between employees and management."* He further elaborated that *"Managers should understand and listen to their employees because then employees' loyalty is increased and the company regulations are applied easily."*

The need for collaboration was identified as important due to the extent to which the companies regarded collaboration as a key aspect of achieving health and safety by ensuring all the parties on construction projects played their parts to help achieve safety on projects. On the list of the measures adopted by the construction companies for achieving health and safety on their oil and gas construction projects was the provision of Personal Protective Equipment to their workers. Only a few of the interviewees indicated that the use (PPE) was a key aspect of the measures adopted by their companies. R3 and R4 further iterated that

their organisation provided PPE to workers on sites, which is one of their basic safety protocols.

As discussed above, the different measures adopted by the companies all contribute to the achievement of health and safety on oil and gas construction sites by ensuring the workforce are conversant with relevant issues and take the necessary steps to ensure their safety. All these measures identified notwithstanding, it was quite evident that two important measures were found to have the least priority. These were: (1) cooperation with governmental organisations in maintaining safety for employees and workers; and (2) the provision of sufficient PPE for employees. This result questions whether the interviewees were really committed to health and safety matters, because the provision of PPE was one of the commonest, most basic and important health and safety measures or protocols.

Furthermore, the government is one of the key players, regulators and enforcers of health and safety related matters on construction sites. This is supported by the research of Hughes and Ferrett (2012) which explains that any contractor who envisages undertaking any construction project in Saudi Arabia must present an Environmental Impact Assessment (EIA) to the regulatory authorities. This assessment requires the contractor to demonstrate that his /her health and safety policy is viable. In this way, structured supervision over policies and practices is maintained in the country. Thus, these two factors should have been among the top ranked priorities for health and safety procedures.

5.7 Effectiveness of Implementing Health and Safety Measures in the Interviewees' Organisations

In order to identify the current health and safety measures applied in the Saudi oil and gas construction industry, this study examined the effectiveness of current practices for some organisations through interviews. The results of the effectiveness of health and safety policies were found to be similar across the organisations in this study. According to R1 (large size, upper level) *"In our company, there are effective health and safety programmes such as the Division of Occupational Medicine which helps to prevent any injuries or infection, and boosts general health and safety across the organisation. It's composed of professional medical consultants, health experts and specialists to test employees' hearing and vision periodically."* This is understandable, because R1's organisation is large-sized with subsidiaries in China, Singapore, the United Kingdom and the United States, where they have a reputable and functioning health and safety system. Furthermore, R1 clarified his role as the Environmental Health and Safety General Manager as "*participating in determining the rules or programmes relating to health and safety," "monitoring their implementation," "keeping in touch with the latest updates concerning health and safety programmes"* and *"attending seminars relating to health and safety*." Similarly, R2 (large size, middle level) stated that *"we have employees with a lot of experience in oil and gas companies and these employees help to raise the reputation of the company worldwide because of their commitment to occupational health and safety measures."* He then continued by saying, "*When some trouble occurs that is beyond our capability to rectify, we hire skilled and experienced teams to solve the problem effectively for us."*

R3 (large size, lower level) and R2 again attested that their organisation provided their employees with protective clothing against potential hazards. R4 (medium size, upper level) and R7 (small size, upper level) stated that their organisations held periodic meetings between the managers and staff to discuss the health and safety programmes in terms of the incidents and in order to identify their causes. In addition to this, R7 further confirmed that his organisation implemented the regulations and laws of occupational health and safety. According to him, *"I participate in determining the necessary measures for health and safety, because the company I work with gives me the opportunity to participate in programmes organised by large-sized oil and gas companies."* Similarly, R5 (medium size, middle level) stated that, *"we offer seminars and training courses relating to health and safety in hazardous environment. We also have experts and inspectors to make sure that all health and safety rules were followed accurately."* R9 (small size, lower level) also stated that in addition to monitoring all minor and major details relating to machinery, *"they offer seminars and training courses to make sure that health and safety measures are applied to prevent the exposure of workers to hazards in the workplace."*

R6 (medium size, lower level) was asked to elaborate on the actions taken by the management in his organisation to prevent exposure to health risks in the workplace. He enumerated that they *"undertake continuous field monitoring, implement risk management plans, analyse any possible dangers that may arise during site works, and raise the level of awareness of employees on H&S issues."* From the findings above, all but R8 (small size, middle level) attested that their organisations had applied safety measures in one way or the other. Thus, it may be sufficient to say that there is a fairly effective health and safety system in the

respondents' organisations. However, evidence from the interview shows that most of the organisations hand pick certain measures, particularly those that are easy to implement and do not require much expense, while leaving out other crucial ones. This supports what is stated in various literature sources, including that of Hinze (1997) and Haadir and Panuwatwanich (2011) who posit that the level of construction safety in the Kingdom of Saudi Arabia is relatively low compared to that in developed countries, due to the absence of strict adherence to the existing regulations.

Thus, there is a dire need for improvement in this situation. It is against this backdrop that this study aims to develop a model for the Saudi Arabian oil and gas construction sector so that they are able to acquire the numerous benefits of a functioning health and safety system.

5.8 Importance and Benefits of Applying Health and Safety Measures

Interviewees were asked to state their opinions on the importance and benefits of implementing health and safety measures in an oil and gas construction company. All the interviewees suggested that health and safety on projects presented many benefits. This is in line with the research of Kenrick (2012), who states that the Middle East is now taking the issue of the health and safety of construction workers seriously and implementing various measures in this regard. The benefits of applying health and safety measures in the oil and gas construction industry in accordance with the opinions of the interviewees were identified and tabulated in Table 5.3.

Table 5.3: Importance and Benefits of Applying Health and Safety Measures

S/No	Benefits	Number of interviewees suggesting these measures	Interviewees
1	Raising the level of productivity	6	R1, R2, R4, R7, R8, R9
2	Protection of workers or employees from any potential hazard	6	R1, R3, R5, R6 R8, R9
3	Maintaining the company's reputation	4	R1, R4, R7, R8
4	Financial losses	4	R1, R3, R7, R9
5	Raising company loyalty of workers and employees	3	R1, R3, R4
6	Preventing any delay in the workflow	3	R1, R6, R9
7	Protecting the environment	2	R1,R9
8	Raising clients' satisfaction	1	R2, R6
9	Raising employees' awareness and experience concerning work regulations and safety measures	1	R6
10	Demonstrating employees' competence and awareness	1	R3

Raising the level of productivity and protection of workers or employees from any potential hazard appear to be the most agreed benefits of applying health and safety measures in the oil and gas construction industry. As discussed earlier, accidents usually lead to stoppages or a drop in productivity, particularly when fatal. This is confirmed by R7 who considered that "*productivity is increased when health and safety measures are adhered to because any malfunctions lead to delays in production*." Similarly, R4 stated that *"I am satisfied when a functioning health and safety system is applied. This is because of productivity increases, good reputation and the company can achieve its targeted profits."*

The protection of workers against potential hazards is the most important factor, and therefore a major benefit of implementing H&S measures. Efforts to prevent the occurrence of accidents in the first place are the most important approach, as pointed out in the literature (Abdelhamid and Everett 2000, Noble 2012, Kolo 2014). This is because, among other reasons, accident prevention saves lives, maintains a company's reputation (R1, R4, R7, R8), averts any financial losses in the case of deaths or injuries (R1, R3, R7, R9), raises the level of loyalty and confidence of workers or employees to do better on site (R1, R3, R4), prevents any delays in the workflow (R1, R6, R9), protects the environment (R1, R9), and raises clients' satisfaction (R2, R6).

In the course of the interviews, follow-up questions were directed at R1, R7 and R4. The question was asked as to why they implemented these measures in their organisations. R4 categorically stated *"honesty and credibility at work"* were his reasons, while R7 enumerated compliance with international and national laws, providing environmental safety for employees, raising productivity and raising the level of safety measures of the company. R1

responded to the question by saying, *"we care a lot about our employees' health and safety first, but we also apply H&S measures to prevent any delays, financial losses and time losses."* This supports a similar assertion made by Nahmens and Ikuma (2009), who pointed out that the prevalence of accidents on site is sure to lead to a domino effect of project problems, including delay, financial losses, employees' lack of confidence, litigation, client dissatisfaction, and expenses incurred through treating accident victims.

The above findings indicate that the majority of professionals in the Saudi oil and gas construction industry were aware of the positive outcomes from the application of safety practices on construction sites. What needs to be considered, therefore, is how to develop or improve health and safety strategies and policies that would favour both the organisations and the workers directly involved in the work process.

5.9 Barriers to the Implementation of Health and Safety Measures on Oil and Gas Projects

Another important theme from the research was the identification of the issues serving as barriers to the implementation of health and safety measures on oil and gas construction projects. From the viewpoint of all interviewees, it was identified that achieving health and safety on oil and gas construction sites was bedevilled with many issues which impeded and interfered with the achievement of accident free construction. These factors include:

- a low level of education among construction site workers,
- poor understanding of health and safety issues,
- problems with construction equipment (faulty equipment),
- disregard for health and safety among employees and

- Poor commitment level of employees towards health and safety.

Although commitment was identified as being one of the main measures adopted to ensure good practice at oil and gas construction sites, the results from this research indicated that this was a major problem for the companies as quite a large number of site staff (employees) were not committed to health and safety. This lack of commitment was identified as being linked, to a large extent, to the low level of education of site staff and poor understanding of health and safety matters. In relation to the disregard for safety on site, interviewee R1 lamented that *"It is surprising sometimes to see that you have to beg workers to be fully kitted with PPEs for their own protection. That is why I'm particularly pleased with the demo on the worst-case scenarios of accidents that is shown during the health and safety training session organized by our company."* This indicates that where site staff disregard their health and safety, it becomes a barrier to achieving safety on site and this is as a result of the low level of education of site teams. As explained by R1, this means workers have to be schooled on safety issues by identifying different means of education which work for the site. The ability to explain or demonstrate to workers the implications of not adhering to health and safety policies is very important, as stated in the literature (Kadri et al. 2014).

According to R2, *"Our organisation is committed to occupational health and safety measures; however, some minor troubles affect the workflow, such as malfunctions in digging machines, but we usually solve this issue by hiring skilled and experienced teams to solve this problem efficiently."* This is not surprising, as R2 works in a large-sized company owned by the government and therefore the company cannot afford any surprises. Therefore,

specifically for oil and gas construction projects, machine errors or faults become a key barrier to achieving occupational health and safety.

5.10 Summary of Chapter Five

This chapter has presented the analysis of the results from the qualitative data collection involving interviews with nine professionals from construction companies involved in oil and gas construction work. The key themes presented in this chapter cover areas such as:

(1) planning for health and safety;

(2) measures adopted to achieve health and safety;

(3) effectiveness of such measures;

(4) the importance of such measures in achieving health and safety and

(5) the barriers to the achievement of health and safety.

The interviews explored the effectiveness of H&S measures within nine oil and gas construction companies of different sizes operating in the Kingdom of Saudi Arabia. It also sought the opinions of professionals on the importance and benefits of applying health and safety measures, the reasons for applying such measures, the role of the interviewees' organisations in preventing exposure to risks, and the measures that need to be taken under the health and safety provisions.

The interviewer has been able to identify the role played by the respondents' organisations in preventing exposure to health and safety risks on site. Among these roles were: creating awareness and offering training on health and safety issues, providing PPE to workers on site, and organising in-house periodic meetings regularly to discuss safety issues between all managers and the staff under their command.

From these results, it was deduced that the majority of the organisations surveyed in this study employed safety measures in one way or the other, but in spite of this, it seemed that, as shown previously by Jannadi and Bu-Khamsin (2002), safety management in the Saudi oil and gas construction industry was still not up to the mark. Therefore, either there are no specific rules, policies and guidelines to maintain safety on site or there is no strategic framework or model agreed by all stakeholders to facilitate the successful adoption of these. Nevertheless, this study was set out to develop a health and safety management model that will consider the country-specific issues and the published best practice from various literature sources.

The results of the benefits of the safety practices indicated that all the benefits identified are positive for the Saudi oil and gas construction projects. However, the major benefits identified by the interviewees were: raising the level of productivity, protection of workers from any potential hazards, maintaining the company's reputation, a reduction in financial losses and raising the loyalty of workers in the company. The overall results indicate that the majority of professionals were aware of the positive outcomes from the application of health and safety measures on construction sites. The only factor left to look out for was how to develop or improve health and safety strategies and policies that would favour both the organisations and the workers directly involved in the work process.

In an attempt to identify the current measures applied in the Saudi oil and gas construction projects, this study examined the effectiveness of the measures applied by nine companies. The results revealed that large-sized and some capable medium-sized companies usually delegated consultants to take care of any health and safety issues that may arise on site, while

other companies managed to employ some subtle measures that were considered insufficient. Taking the overall results, it was deduced that there was a fairly effective health and safety system within Saudi oil and gas construction projects, but this was not sufficient. In other words, there was an urgent need for the improvement of health and safety practices or policies.

In line with this, the current study, through in-depth interviews, sought the opinions of professionals on what H&S measures they considered necessary in preventing the occurrence of accidents on construction sites.

The result indicated that importance should be given to planning, monitoring and implementation, monitoring and improving the level of awareness concerning occupational related accidents that could affect health, a periodic investigation of any hazards or malfunction in machinery and equipment, a commitment to health and safety programmes by workers, and keeping in touch with the latest updates.

From these findings, it was clear that interviewees' were conversant with what health and safety entailed, and their suggestions on the way forward for implementing them was thoughtful. However, there are still lots of steps the respondents failed to mention, while some important characteristics were not prioritised, such as; cooperation with governmental organisation in maintaining safety for employees, and the provision of sufficient Personal Protective Equipment (PPE) for employees.

All the same, the health and safety management model to be developed in the next chapter will consider the above stated results and observations, the country-specific characteristics,

and published best practice from various literature. The results from this chapter influenced the design for the quantitative data collection instrument.

CHAPTER SIX (6): QUANTITATIVE DATA ANALYSIS

6.1 Introduction to Chapter 6

This chapter presents the quantitative data with the aim of identifying patterns in the data. It identifies the key issues impacting health and safety management in oil and gas construction projects in Saudi Arabia.The essence of the quantitative data collection, is to ensure that a representative sample is selected that addresses these issues within the Saudi Arabian oil and gas industry.

The chapter is divided into three main sections: Section one analysis the demographics of the participants for this research, while the second section presents a descriptive analysis of their responses to the questions. The third section presents an inferential analysis of the results based on different statistical tests conducted.

6.2 Demographic Analysis of Data

This section analyses the distribution of the participants in terms of their position within their organisation, their years of experience, the number of employees in the organisation and the type of work done by the organisation. A random sampling was used as the basis to select respondents for this research, involving different professionals working in different sizes and types of companies. The demographic information gathered from the respondents helped to form a better picture of the experiences and the background of the research participants including the activities of their respective companies

6.3 Distribution of Survey Respondents

This section presents the demographic information from the respondents to the survey based on seven main factors. These include: the age the respondents; years of experience ; current role in the companies; years of experience in the current role; the size of organisation they work for; the number of workers in the organisation; and the type of company they work for.

6.3.1 Age of Respondents

The distribution of the respondents by age as shown in Table 6.1 indicates that of the 200 respondents to the survey, as many as 61 respondents, constituting 30.5% are over the age of 45 years. The age range of the second highest distribution is between 40 and 44 years. This is made up of about 20% of the respondents. About 17% of the respondents were aged between the ages of 35 and 39 years old. 17% were also between 30 and 34 years. The remaining 15% of the respondents were below the age of 30. This suggests that generally the respondents of the survey were mature people.

Table 6.1: Age distribution of respondents

Age of Respondents			
	Frequency	Percent%	%(Cumulative)
Under 25 years	22	11.0	11.0
25 - 29 years	8	4.0	15.0
30 - 34 years	35	17.5	32.5
35 - 39 years	34	17.0	49.5
40 - 44 years	40	20.0	69.5
Over 45 years	61	30.5	100.0
Total	200	100.0	

6.3.2 Years of experience working in the construction industry

To ensure the survey respondents had enough experience to contribute to this research, the number of years they had worked in the industry were captured. Figure 6.1 summarises responses of practitioners with an average of 10 – 15 years' experience in the industry.

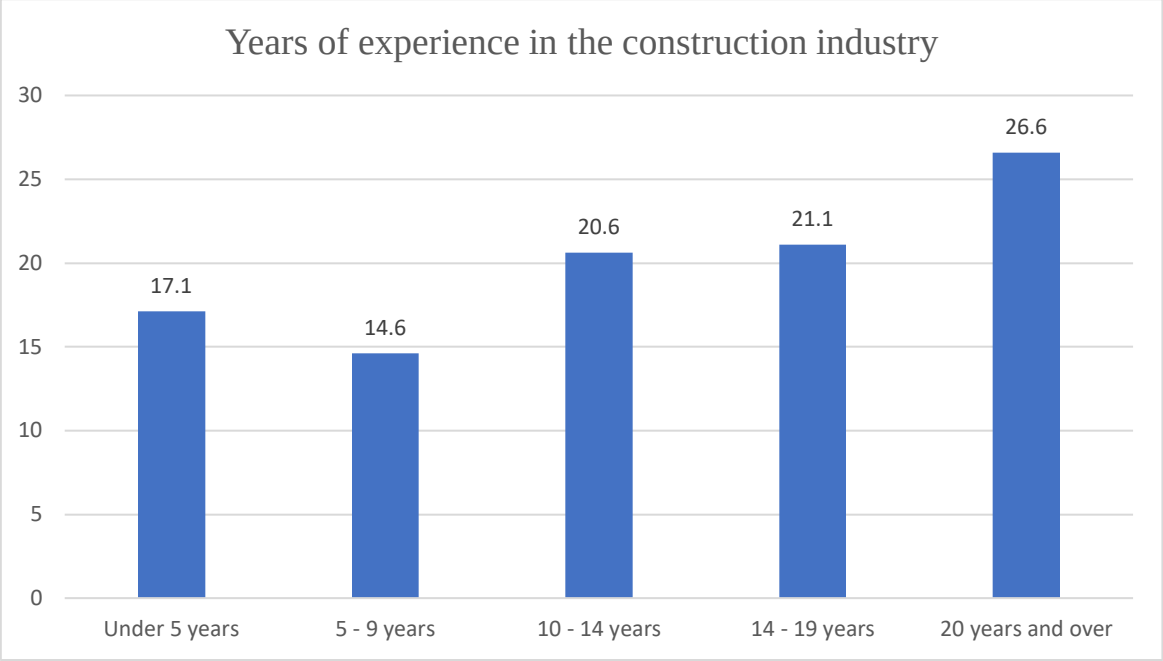

Figure 6.1: Years of Experience of research participants in the construction industry

6.3.3 Distribution of Respondents by Job Roles

Figure 6.2 shows over 20 percent of the respondents were quantity surveyors and environmental and health and safety managers respectively. About 19% of the respondents were site managers. 16.1% were construction managers whereas the remaining 15.1% were project managers. Overall the views presented in this study come from a broad spectrum of professionals from the construction sector of KSA.

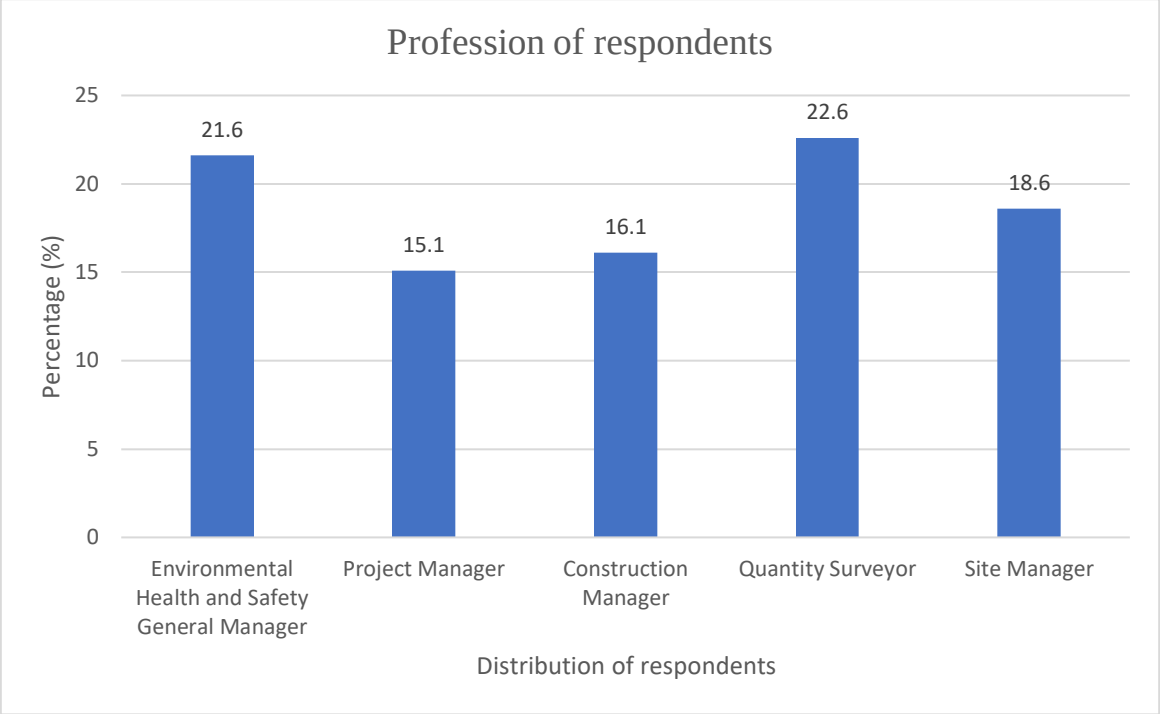

Figure 6.2: Profession of respondents

6.3.4 Years of Experience in Current Role

To ensure that that respondents demonstrated adequate understanding and knowledge of the relevant issues, the research sought to identify the years of experience in their roles. Figure 6.3 indicates that, about 27% of the respondents had less than 5% of experience in their roles while over 21.7% of the respondents had about 20 years or more. 19% of the respondents had between 10 and 14 years of experience. Therefore the interviewees were generally in their current roles long enough to understand matters relating to health and safety.

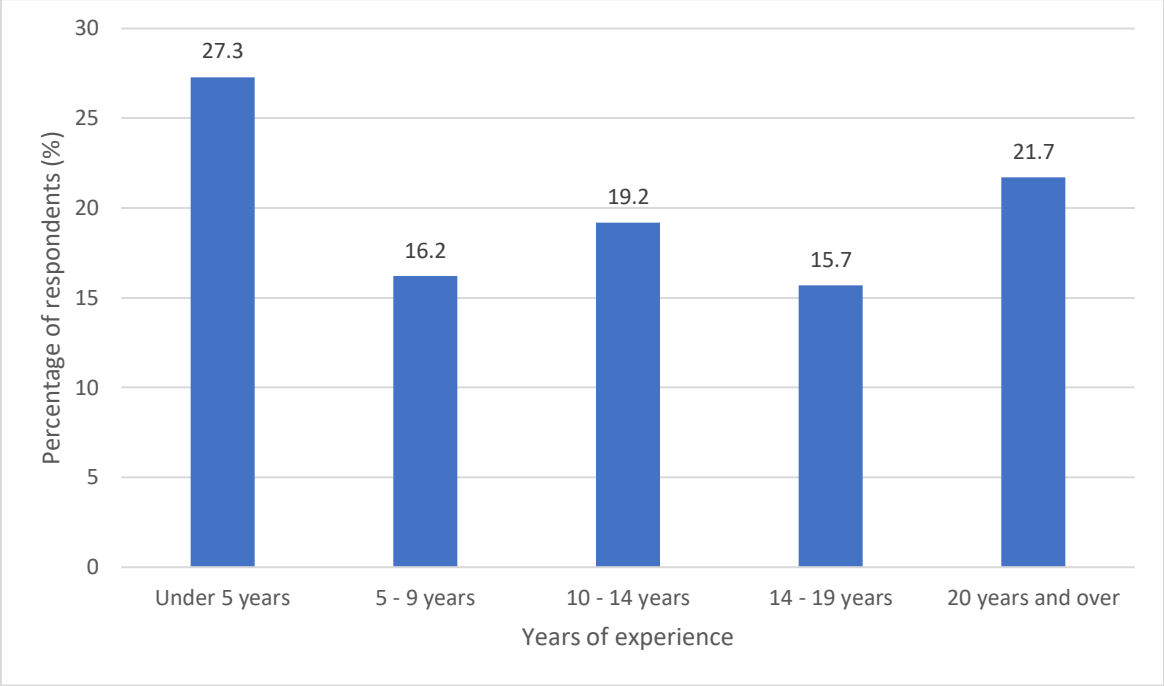

Figure 6.3: Experience of respondents in their current roles

6.3.5 Size of Construction Companies

To provide a better overview of the results of the research, the sizes of the companies' the respondents work for was studied. The results shown in the Figure 6.4 indicate that 36.7% of the respondents work for medium sized companies. 34.2% of the respondents were from large companies and the remaining 28.6% worked for small scale companies. This indicates that respondents of the survey come from different sizes of companies and this helps to ensure that the outcome of the research will be applicable to construction companies of different sizes.

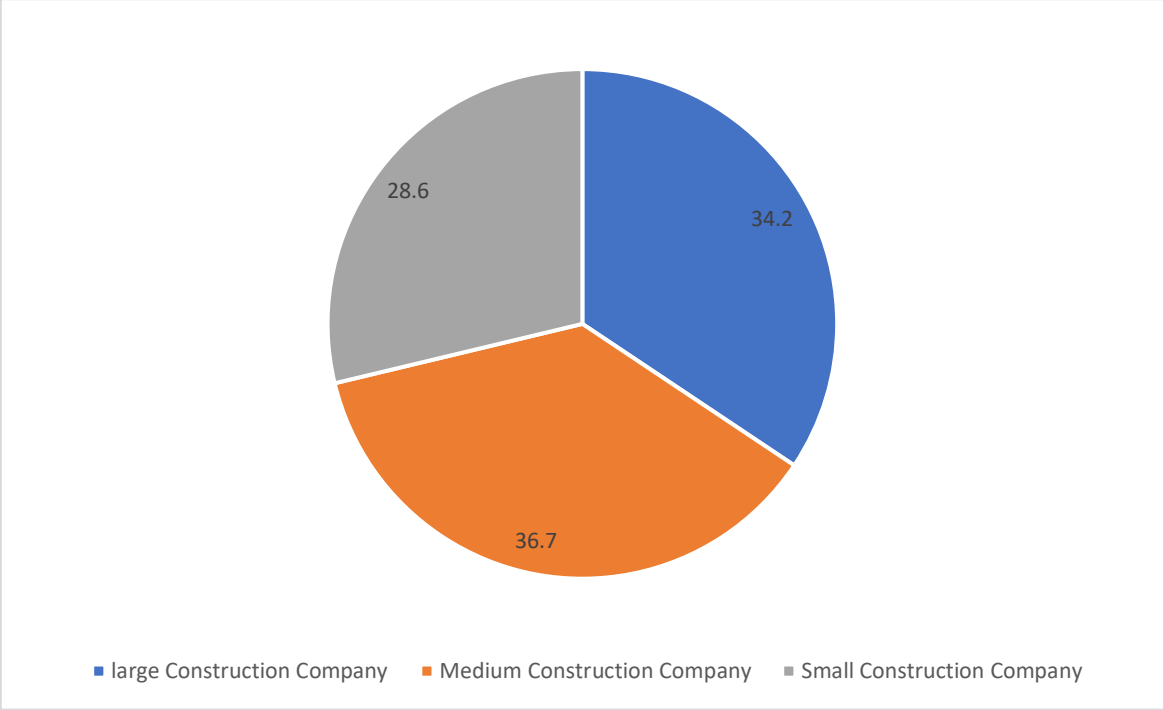

Figure 6.4: Distribution of respondent's company size

6.3.6 Number of Workers in Respondent Companies

The study shows that respondents come from companies with different sizes and number of workers indicating that the number of respondents for this research are generally fairly distributed among the different sizes of companies. This is shown in the Figure 6.5

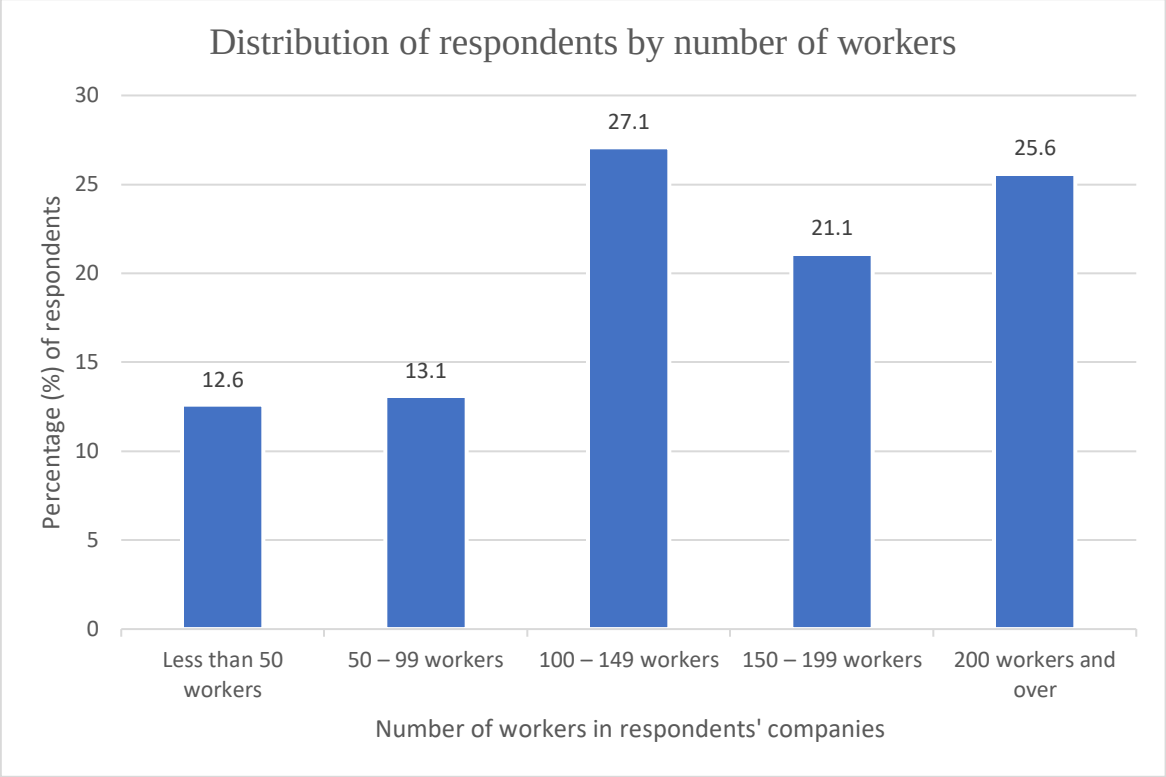

Figure 6.5: Distribution of respondents in different sizes of companies

6.3.7 Type of Company

The last demographic variable investigated in this research was the type of company the respondents worked for. Figure 6.6 shows that there was generally a good distribution of respondents from different types of companies. There were 31.6% of the respondents worked for sub-contractors. 26.5% of respondents worked for main contractors, and 26% of respondents worked for consultant firms. 15% of the respondents worked for unclassified companies.

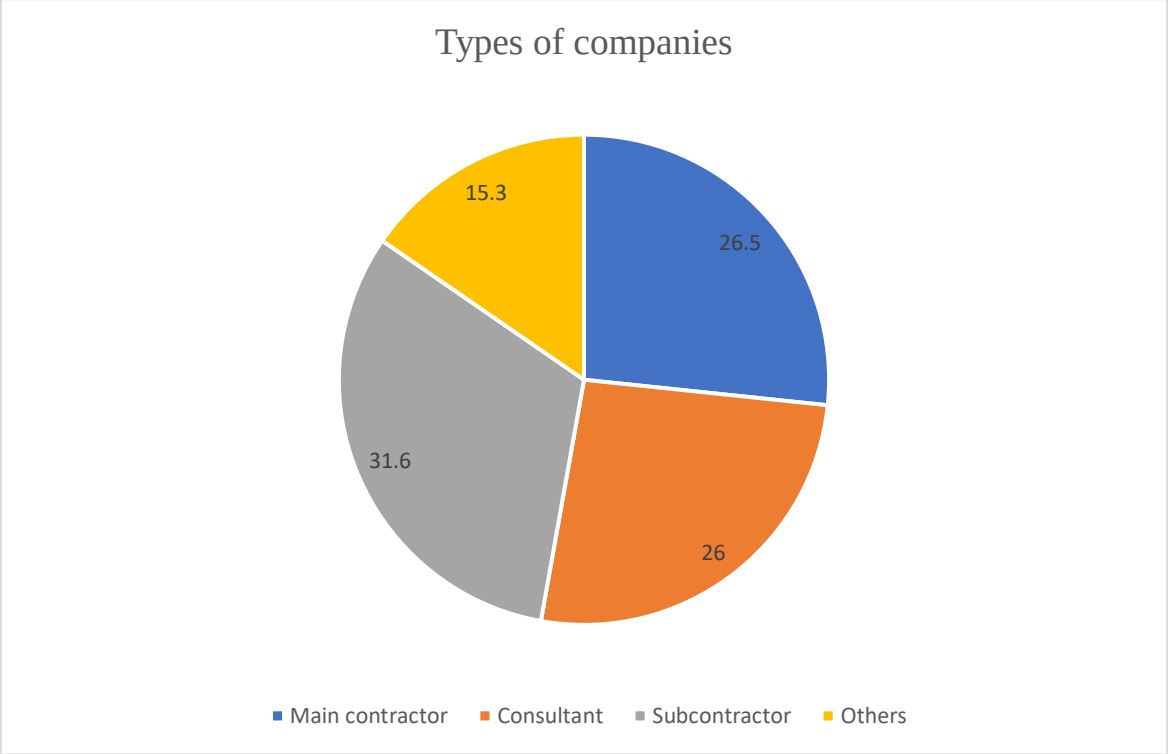

Figure 6.6: Distribution of companies who responded to the questionnaire

6.4 Oil and Gas Projects Participation

In this section, distribution of projects executed by the respondents' companies are presented. In general there were 5 different types of oil and gas construction projects associated with the participants. These are comparable to the oil and gas construction projects reviewed in the literature by Taylor and Carson (2014) and Ruqaishi and Bashir (2015), who report that major oil and gas construction project include: offshore platforms; oil platforms and production lines; offshore oil fields; oil refineries; and oil and gas drilling facilities. The extent to which participating companies are involved in these projects are discussed below.

6.4.1 Offshore platforms

In terms of off shore platforms, the respondents were asked to indicate whether their companies undertook offshore platform projects. 53% of the respondents indicated that their companies had undertaken offshore platform projects whereas 47% of the respondents had not undertaken offshore platform projects.

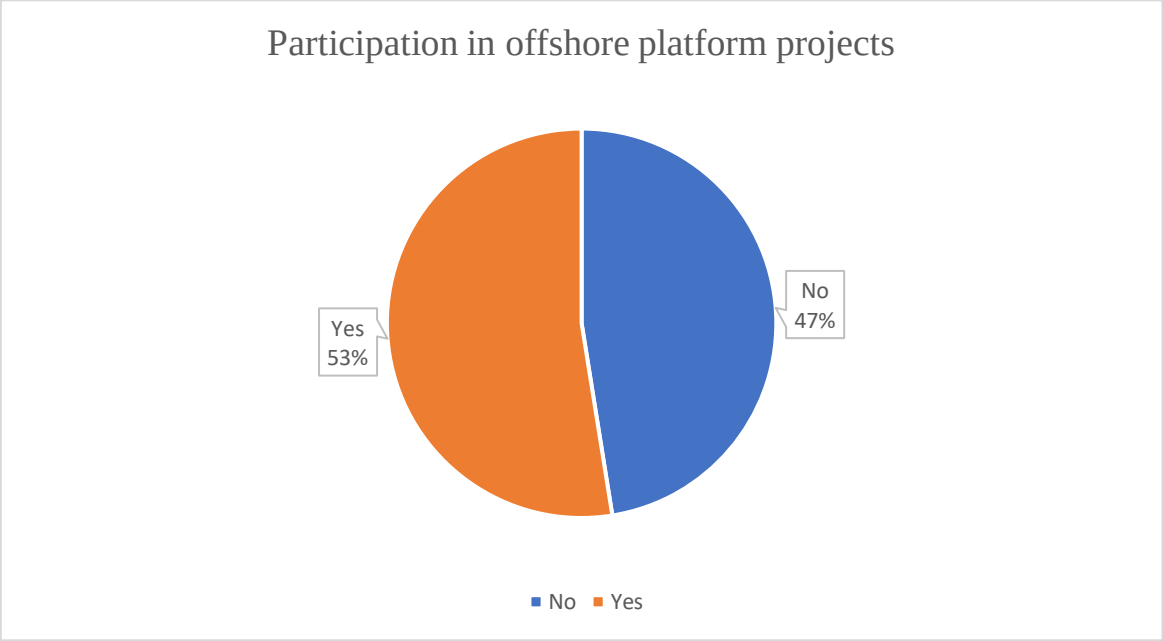

Figure 6.7: Participation in offshore platform projects

6.4.2 Oil Platforms and Production Lines

The next type of project involved construction of oil platforms and production lines. Figure 6.8 showed that 55% of the respondents worked for companies who had undertaken construction projects for oil platforms and production lines, while 45% had not previously participated in these types of projects.

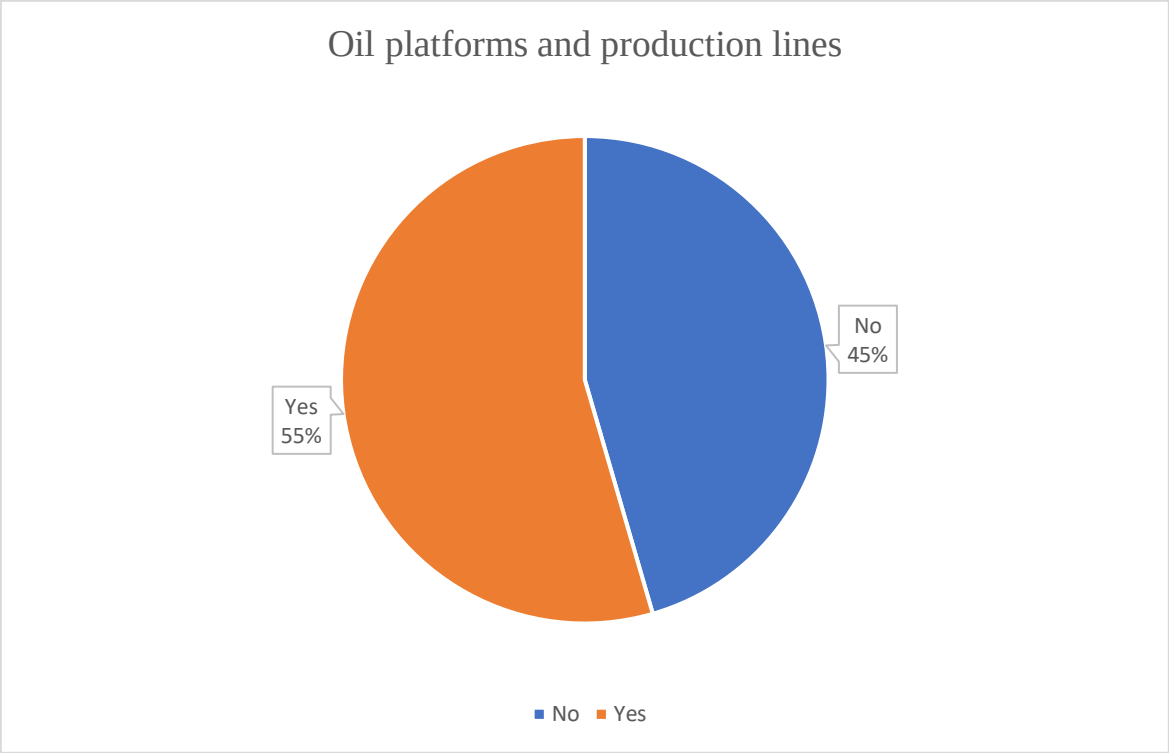

Figure 6.8: Construction of oil platforms

6.2.3 Offshore Oil Fields

Another type of construction project presented to the respondents was about offshore oil fields. From the responses shown in Figure 6.9, it was evident that it was not one of the most common oil and gas construction projects for the respondents. A little over half of the respondents, 51%, indicated that their companies had undertaken projects involving offshore oil fields. The remaining 49% had not undertaken projects involving offshore oil fields.

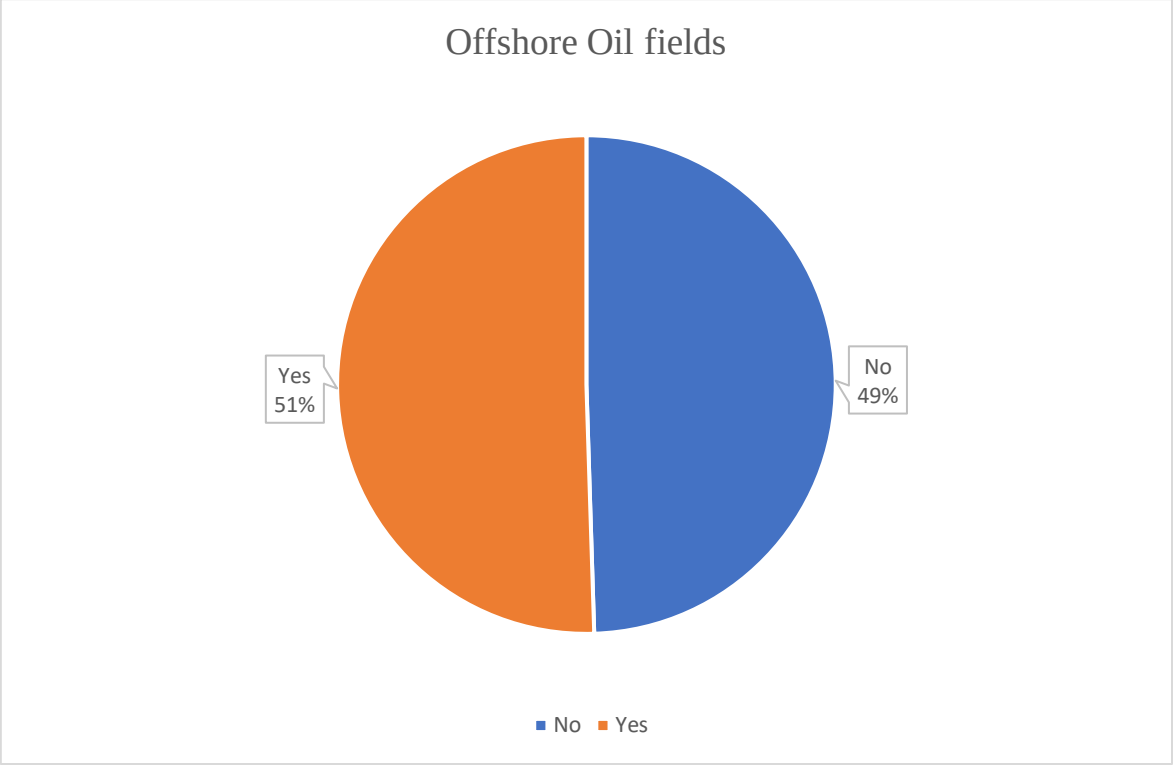

Figure 6.9: Construction of offshore oil fields

6.4.3 Oil Refineries

According to Figure 6.10 less than half of the respondents work for companies who had undertaken projects involving oil refineries. Only 49% of the respondents had worked for companies on projects involving the construction of oil refineries

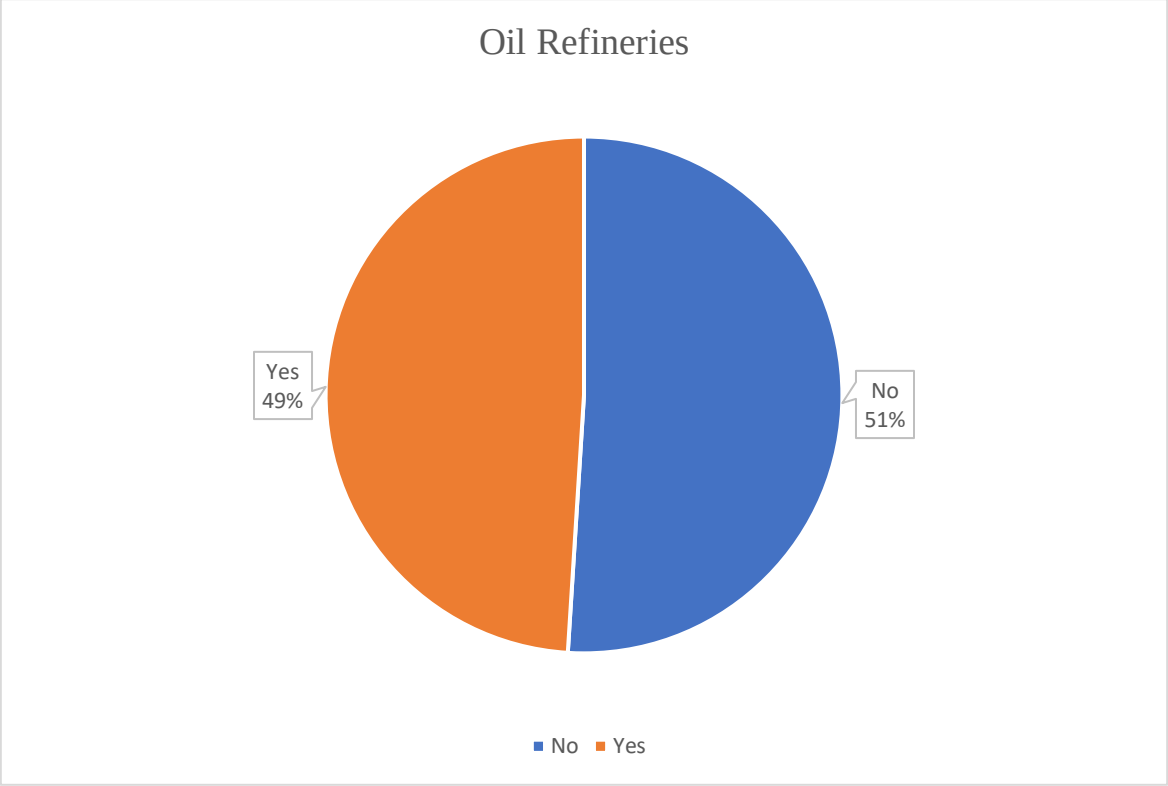

Figure 6.10: Construction of oil refineries

6.4.4 Oil and Gas Drilling Facilities

Figure 6.11 shows that 53% of the respondents worked for companies which have experience in projects involving the construction of oil and gas drilling facilities. 47% had not been involved with projects involving oil and gas drilling facilities.

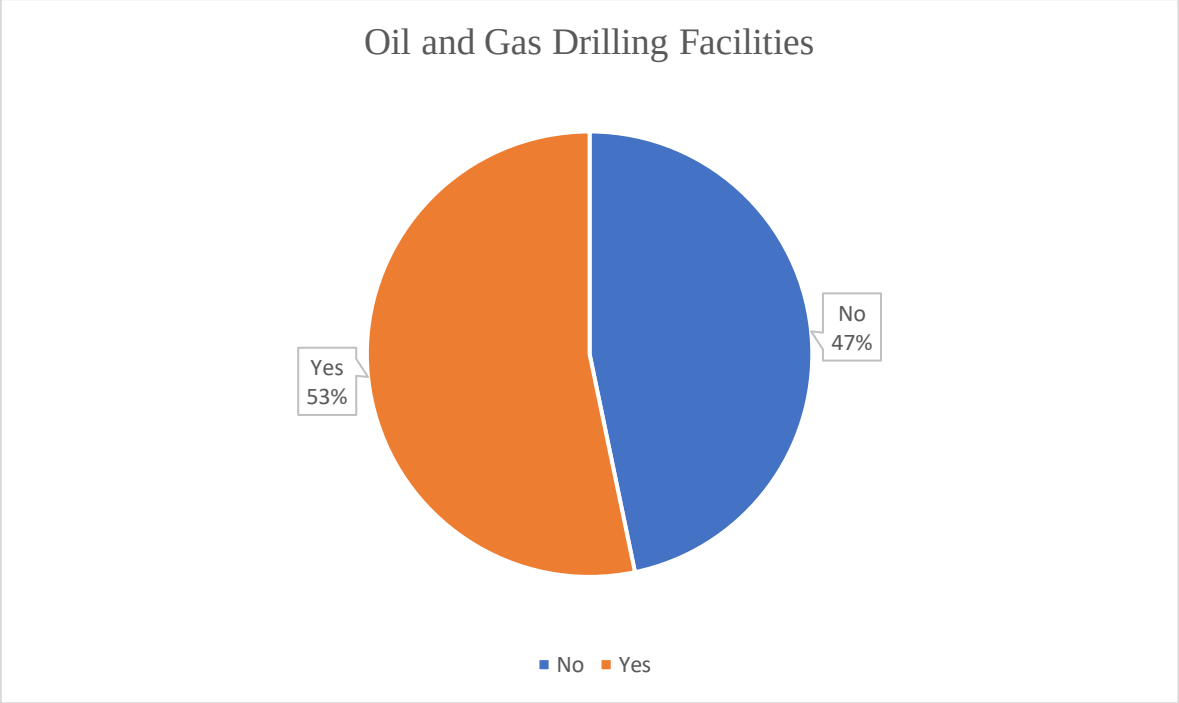

Figure 6.11: Construction of oil and gas drilling facilities

The results of the research indicate that each respondent in this research worked for a company that had undertaken at least one oil and gas construction project. This made the respondents appropriate for this study because of their involvement in oil and gas construction projects. The results also indicated that the most common oil and gas construction projects among the respondents are oil platforms and production lines, followed by oil and gas drilling facilities and offshore platforms.

The results indicate that oil and gas drilling facilities, offshore fields, offshore platforms and production lines were the commonest forms of oil and gas construction projects the participating companies were involved in.

6.5 Health and Safety Management and Policies

This section of the chapter presents results for analysis of data on the health and safety management issues and policies and measures adopted by the companies to manage health and safety on oil and gas construction projects undertaken in the Saudi Arabian construction industry.

6.5.1 Involvement in the Formulation of Oil and Gas Policies

The extent to which respondents were involved in the formulation of oil and gas policies within the construction companies of respondents was measured. The results shown in Figure 6.12 indicate that as high as 77 of the 198 valid responses for this question were always involved in the formulation of health and safety policies in their companies. This makes up about 39% of all the respondents. About 26% indicated that they were frequently involved in the formulation of health and safety polices for their companies. This shows that at least 65% of the respondents in this research were involved to a very high extent in the formulation of health and safety policies in the companies they worked for. This result confirms that for the majority of the respondents, they ha the required knowledge of health and safety policies. About 27% of the respondents indicated that they were occasionally involved in the formulation of health and safety policies in their companies. Only 16% were rarely involved in the formulation of health and safety policies within their companies.

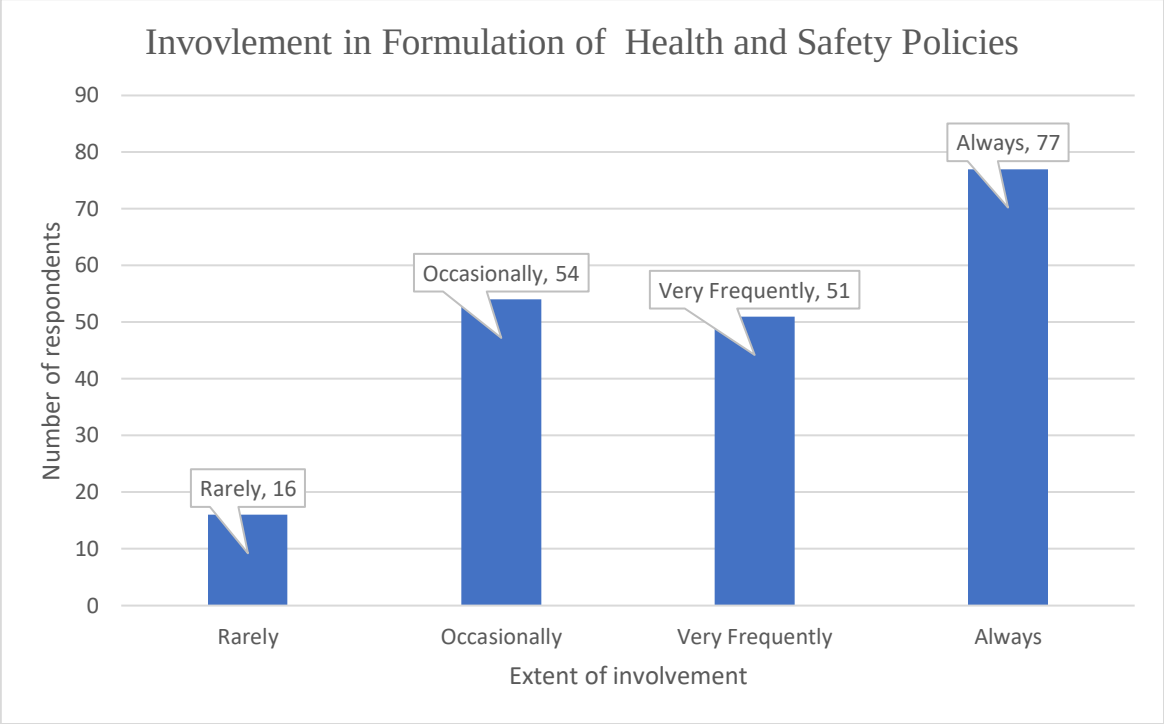

Figure 6.12: Extent of involvement in the formulation of health and safety policies

As reported in the literature, it is a good practice to involve the site teams in the planning and formulation of health and safety policies considering the direct involvement of on-site staff with safety issues. Alasamri, Chrisp, and Bowles (2012) for example report that involvement of workers and management in the formulation of health and safety policies is very important. This view supports research by Jannadi and Assaf (1998) who suggest that planning and implementing safety should be the responsibility of all parties involved. Badiru and Osisanya (2013) also report that site workers serve as a good source of information for formulating health and safety policies.

6.5.2 Contribution of Health and Safety Policies to Improving Health and Safety Management

The respondents were asked to indicate the extent to which health and safety policies in their companies contributed to the improvement of health and safety within their companies. The results shown in Figure 6.13 indicate that 69 out of the 200 respondents (35% of the respondents) agreed that health and safety policies in their companies were extremely influential in leading to improvements in the health and safety management of their projects. 73 respondents, (37% of the total respondents) indicated that health and safety policies were effective in their companies. This indicates that, on the average, about 72% of the respondents found health and safety policies in their companies influential in leading to improvements in health and safety management within the companies. 24% of the respondents indicated that the health and safety management policies within their companies were somewhat influential whereas the remaining 6% found health and safety policies were either slightly influential or not influential at all.

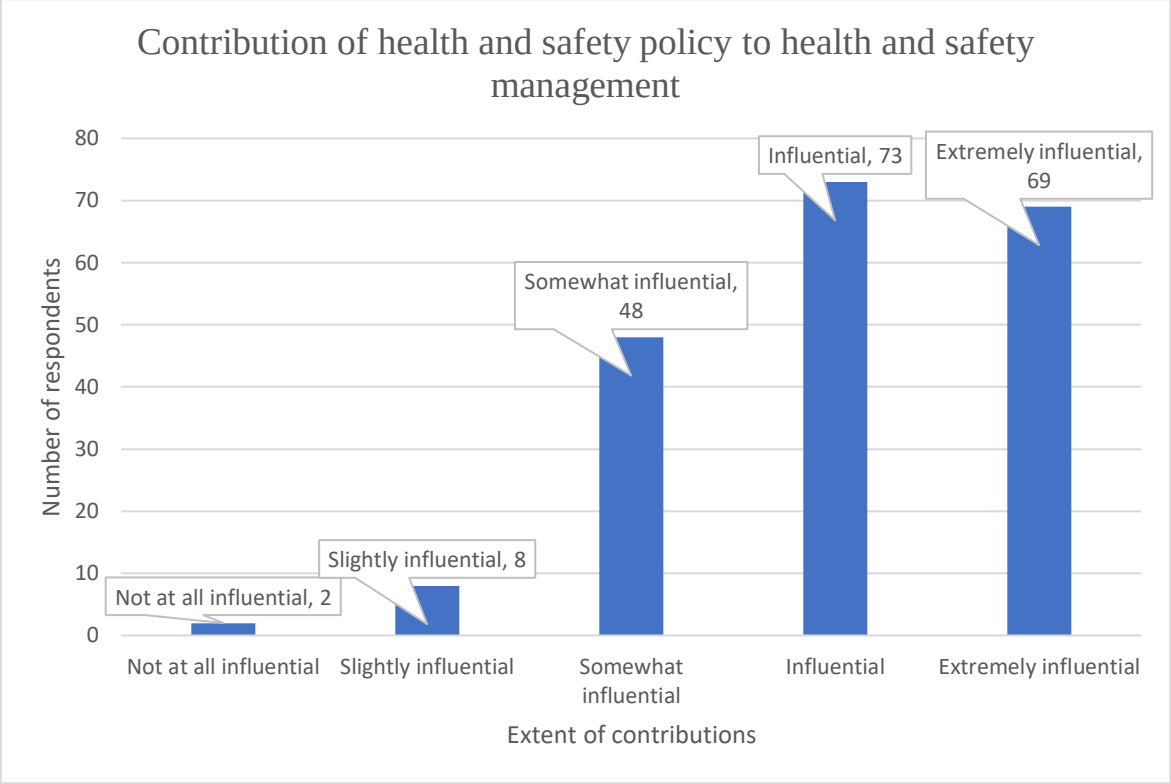

Figure 6.13: Contribution of health and safety policies to improving health and safety management

As shown in the analysis, the participants showed an awareness of correct health and safety policies in relation to its influence on achieving health and safety. This view was supported by Chouldhry et al (2007) who confirmed that health and safety policies were the first step in safety management. Yorio et al (2015) and Karmis (2001) agree that safety management policies influencing the culture of construction projects were beneficial in ensuring the safety of construction workers.

6.5.3 Effectiveness of Legislation in Achieving Health and Safety

The study asked respondents to indicate the extent to which health and safety legislation was effective in achieving health and safety on oil and gas construction projects. The results

shown in Figure 6.14 indicate that out of the 200 valid responses, 53 were of the view that government legislation was effective in achieving health and safety. This makes up almost 27% of the respondents. 60 respondents (30% of the total participants for this research) indicated that government legislation was very effective. This means that 57% of respondents found government legislation effective. There were also about 50 respondents, who were of the view that government legislation was fairly effective. Consequently, 36 respondents (about 18%) found legislation either slightly effective or not effective at all.

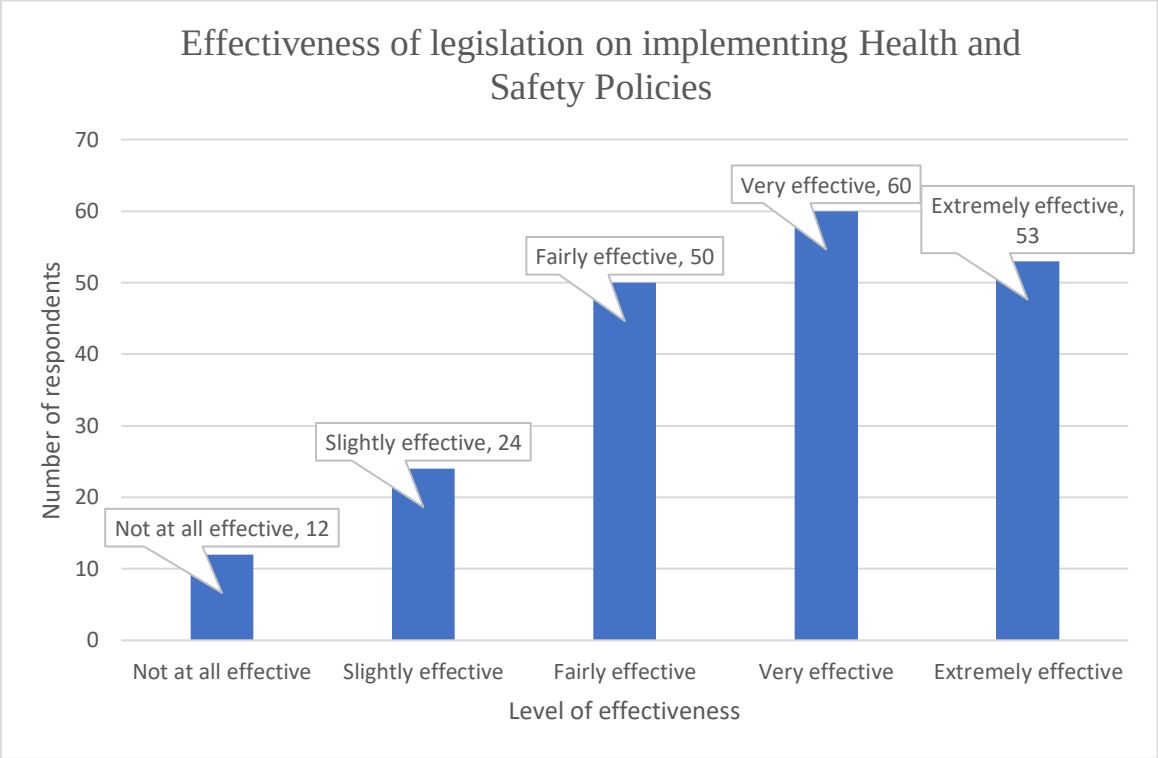

Figure 6.14: Effectiveness of legislation on implementing health and safety policies

Various authors such as Hughes and Ferrett (2012), Ncube and Kanda (2018), and Ganah and John (2015) have reported on the importance of government legislation in improving

safety on construction projects. The results from this research supports such authors in acknowledging the importance of legislation in improving health and safety in construction.

6.5.4 Tailoring Practices to Meet the Demands of Oil and Gas Construction Projects

To ensure health and safety management practices of construction firms meet the demands of oil and gas construction projects, it was important to ensure such practices were tailored to meet the needs of oil and gas construction projects. Respondents were asked to indicate the extent to which the practices in their companies were tailored to meet the needs of oil and gas construction projects. The results shown in Figure 6.15 indicate that as many as 31% of the respondents worked for companies that were extremely effective at tailoring their health and safety practices to meet the demands of oil and gas construction projects. 37.7% also indicated that their companies were very effective at doing this whereas 23.6% indicated that their companies were fairly effective at tailoring their practices to meet the demands of oil and gas construction projects. The remaining 7.5% of the respondents indicated that their companies were either slightly effective or not effective at all. This indicates that, on the average, the majority of the respondents worked for companies that were effective at tailoring their practices to meet the demands of oil and gas construction projects.

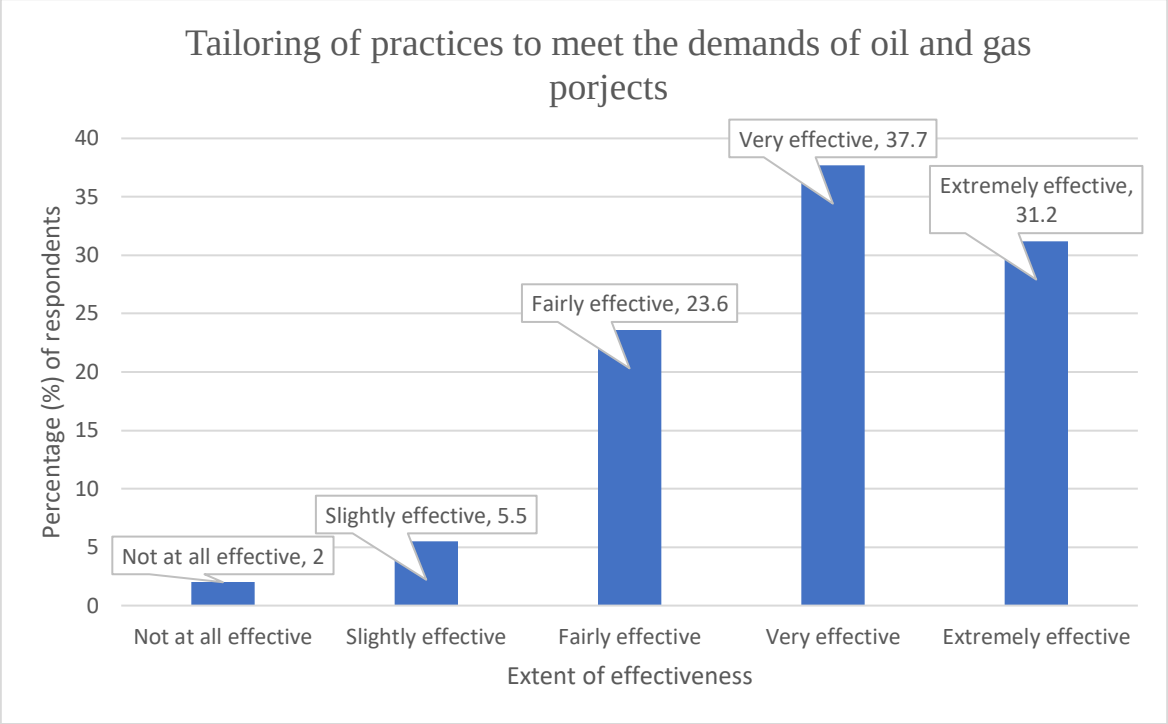

Figure 6.15: Tailoring of practices to meet the demands of oil and gas construction projects

As seen from Figure 6.15 the companies who took part in this research tailored their practices to meet the demands of oil and gas construction projects. This was beneficial as Panuwatwanich (2011), Berends (2007) all report that the nature of safety concerns on oil and gas projects were different from that of safety concerns for normal construction projects. This makes tailoring of practices to suit the demands of oil and gas construction projects very appropriate

6.5.5 Influence of Measures in Achieving Health and Safety on Oil and Gas Projects

The respondents were then asked to indicate the extent to which the measures adopted in their companies were influential in achieving safety on oil and gas construction projects. The

measures identified includes: the provision of PPE to site teams, planning and monitoring of H&S implementation, practices towards improving awareness of site teams, periodic investigation of hazards and malfunctioning machinery, commitment to health and safety measures, keeping in touch with updated policies, improved collaboration between employees and management, seminars on health and safety, and involvement of site teams in developing safety measures and policies. The results indicate that about 38% of the respondents found the measures adopted by their companies to be extremely influential whereas 37% found the measures to be influential. This indicates that at least 75% of the respondents found the measures adopted in their companies to be influential compared to the remaining 25% who found the measures to be only slightly influential or somewhat influential.

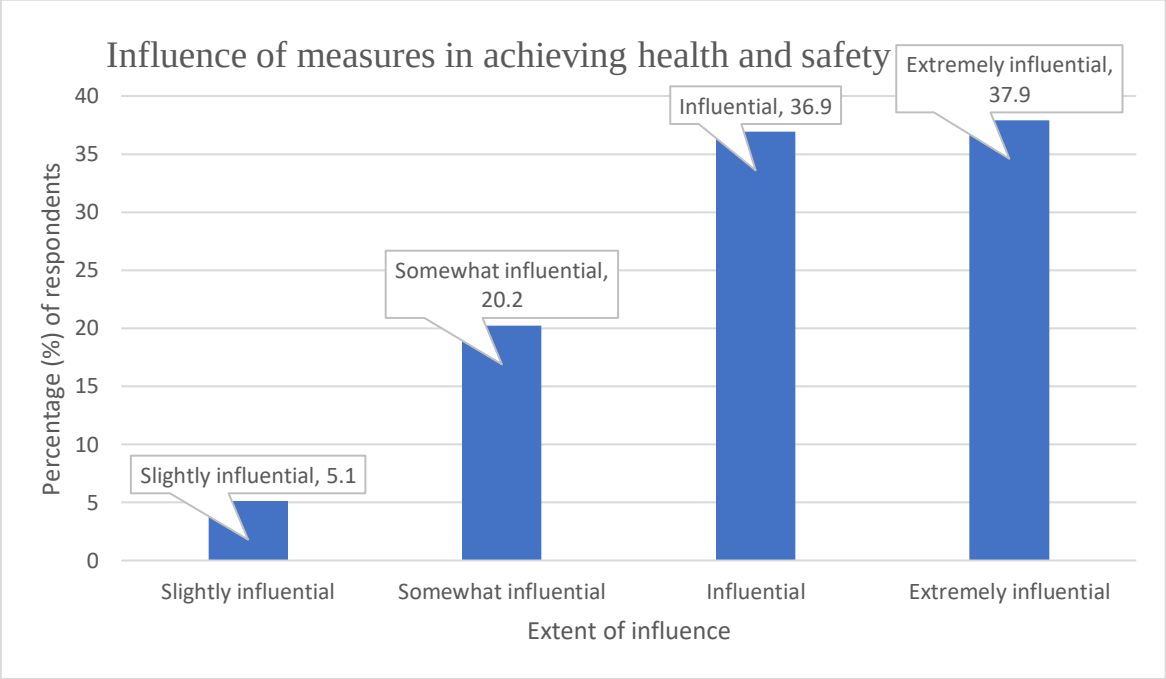

Figure 6.16: Influence of measures in achieving health and safety on oil and gas projects

The essence of designing policies and measures for health and safety is to influence the culture and practices within construction firms to encourage better safety outcomes. The results of this research provides evidence that the measures put in place by the construction companies to are influential to a very high extent.

6.5.6 Familiarity with Health and Safety Policies

The respondents were asked to indicate how familiar they were with health and safety measures in their companies. The results indicate that about 69% of the respondents were either extremely or moderately familiar with the health and safety measures of their companies. The remaining 30% indicated that they were somewhat familiar or slightly familiar with health and safety management measures of their companies. Only 1% of the respondents indicated that they were not familiar at all with the health and safety measures of their companies. This is shown in Figure 6.17.

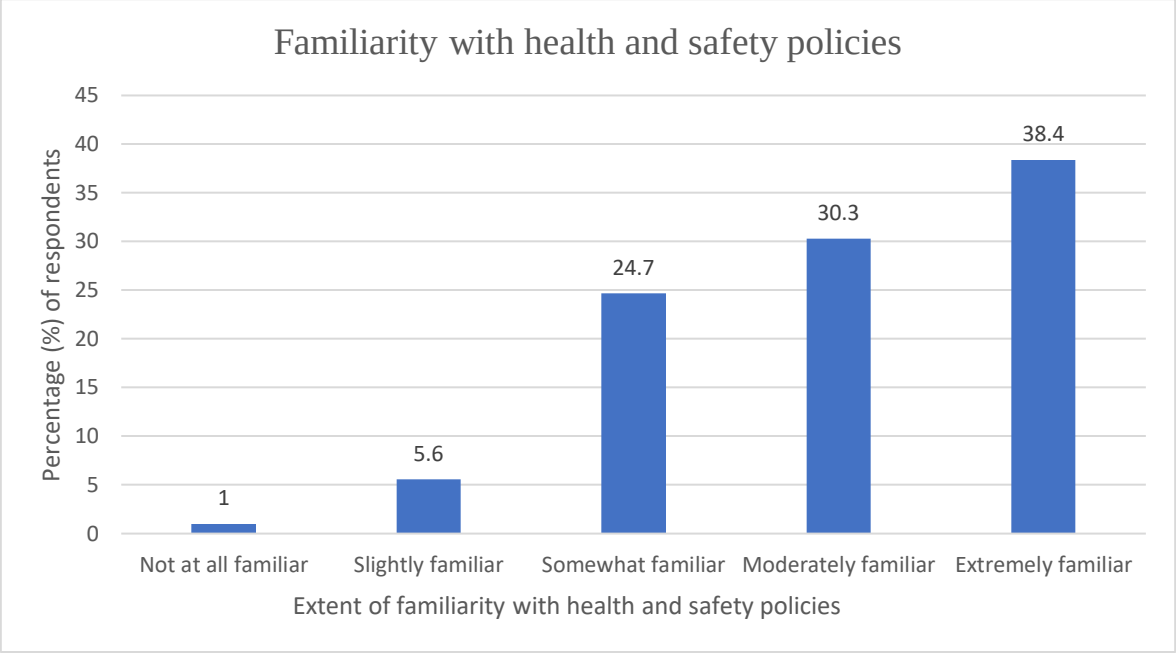

Figure 6.17: Familiarity with Health and Safety Policies

To encourage better performance on construction projects, employees on construction projects should be familiar with the measures designed by their companies to ensure their safety. This research finding indicates that majority of the respondents were familiar with the policies required to keep them safe. In the literature, Hallowell (2012), Oloke et al (2007), and Saleh and Ramadan, (2011)_all report that the increase in accidents on construction sites are as a result of lack of knowledge of safety management practices. The high level of awareness of awareness familiarity with safety policies is a step in the right direction in improving health and safety.

6.5.7 Extent to which Companies Adhere to Health and Safety Policies

This section of the research required the research participants to indicate the extent to which their companies adhered to health and safety policies set up in their companies. The results

indicate that just over 36% of the respondents worked in companies which always adhered to health and safety policies. There were also 32% whose companies often adhered to health and safety management policies. Of all the respondents, about 24.6% and 7% respectively indicated that their companies sometimes or rarely adhered to health and safety management policies. As shown in Figure 6.18 this indicates that generally the companies adhered to the policies they set up to manage health and safety on their projects.

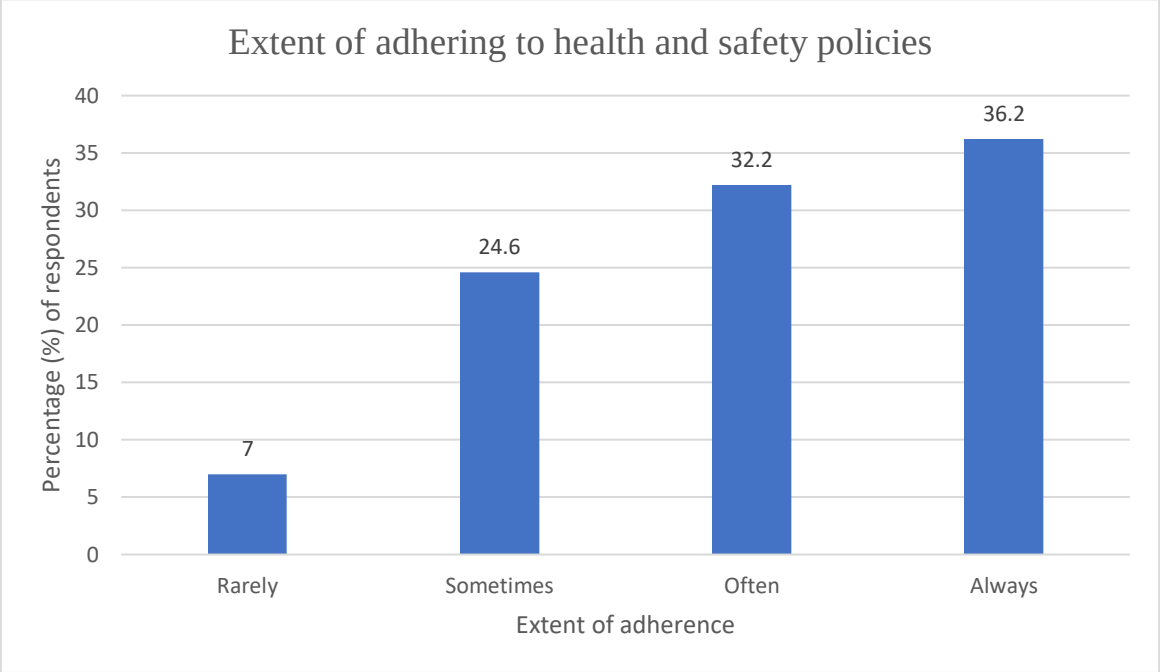

Figure 6.18: Extent to which companies adhere to health and safety policies

6.5.8 Importance of Health and Safety Management to Company Business Processes

This section, analyses the data on the extent to which health and safety management within companies impacts on various activities in the companies. It highlights the impact of health and safety management to enhancing the level of employee productivity, protecting workers from potential hazards, maintaining company reputation, preventing financial loss, raising the loyalty of workers to the company, preventing delay in workflow, helping to protect the environment,raising client satisfaction, raising employee awareness and experience and demonstrating employee competence.

6.5.9 Importance of Health and Safety Management in Raising the Level of Productivity

Analysis of the responses on the importance of health and safety management in raising the level of employee productivity suggests that about 33% of the respondents found health and safety extremely important in raising the levels of productivity. About 20% of the respondents deemed health and safety important and this suggests that for about 53% of the respondents, health and safety played a critical role in ensuring employee productivity is increased. 32% of the respondents also indicated that health and safety policies were important but only moderately in relation to raising productivity levels. Only about 15% found health and safety either slightly important (11.6%) or not important at all (3%) in relation to raising employee productivity. This suggests that there is generally an acceptance that health and safety management has a role to play in ensuring productivity increases.

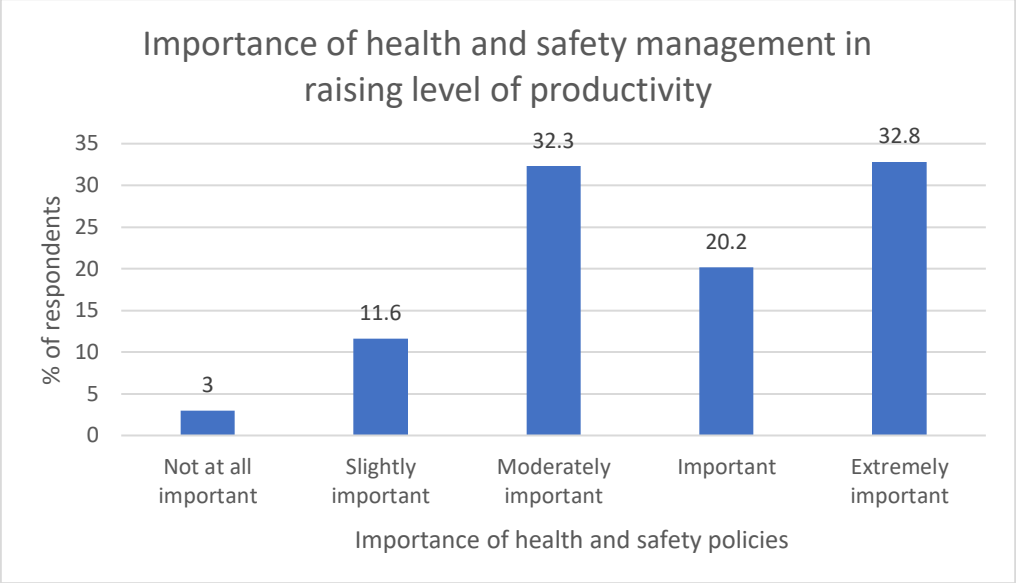

Figure 6.19: Importance of health and safety management in raising the level of productivity

One of the main benefits of improvement health and safety as reported in the literature is the impact on productivity of workforce (Thanwadee, 2009; Walsh and Sawhney, 2004; Sacks *et al.*, 2009). As reported in Teo et al (2005) and Schafer et al (2008) having a safe working environment will contribute to improved productivity and should be encouraged. The results of this research confirm this as participants consider safety policies as important in ensuring productivity and supports the view of researchers such as Chouldhry, 2017; Attar et al., (2012); Soekiman et al., (2011); Nahmens and Ikuma, (2009) ; Kazaz and Ulubeyli, (2007).

6.5.10 ***Importance of Health and Safety Management in Protecting Workers from Potential Hazards***

To prevent potential hazards to employees, the respondents suggest that importance should be attached to health and safety management. As seen in Figure 6.20, over 67% of the respondents deemed health and safety management as either extremely important (32.3%) or important (34.4%) in ensuring employees are protected from potential hazards.

This view can be linked to the ability of management measures and practices to improve the awareness of workers on potential hazards and the empowerment of workers with the necessary tools to help them remain safe during construction activities. As reported in Holt (2008) Kenrick (2012) and Kolo (2014) all report that having the correct measures in places goes a long way to protect workers and ensure they feel encouraged to perform their tasks on site

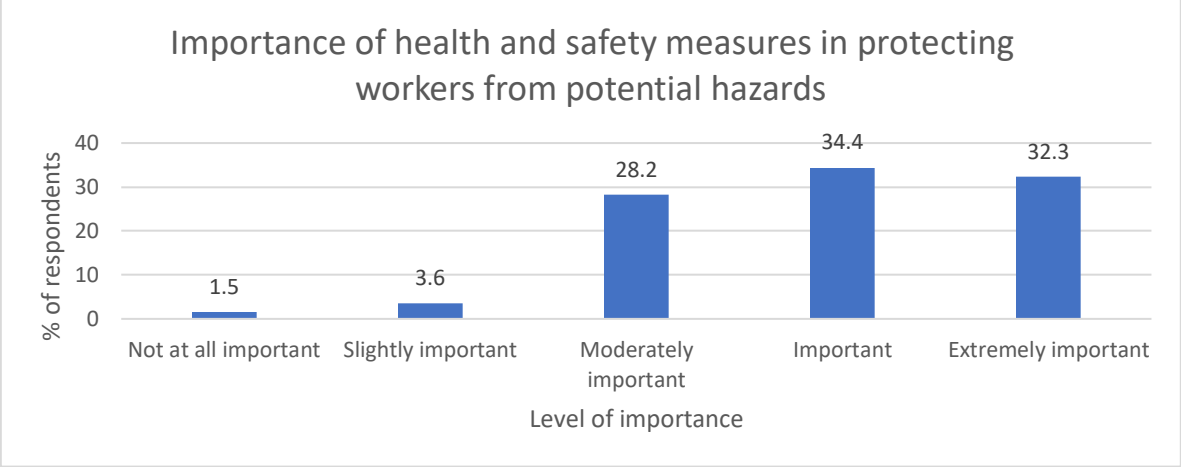

Figure 6.20: Importance of health and safety management in protecting workers from potential hazards

Only about 5% of the respondents deemed health and safety management either slightly important or not important at all in ensuring employees are protected from potential hazards.

The view that health and safety measures are important in protecting workers as identified in this research supports the views from literature. This means workers on oil and gas construction projects will rely on safety policies to protect them from hazards and as such management should ensure such expectations are met by providing the necessary safety measures.

Importance of Health and Safety Management in Maintaining Company Reputation

Reputation is very important in the construction industry as it has an impact on the likelihood of being asked to do work by certain clients. The research respondents were required to indicate the extent to which health and safety management was deemed important in maintaining company reputation. The results shown in the Figure 6.21 indicate that there was a general view that health and safety management was important in maintaining company reputation. About 60% of the respondents (30.1% for extremely important and 29.6% for important) found health and safety management to play a key role in maintaining company reputation. This was followed by 25.5% of the respondents who found health and safety management moderately important. About 15% of the respondents found health and safety management either slightly important or not important at all when it came to company reputation.

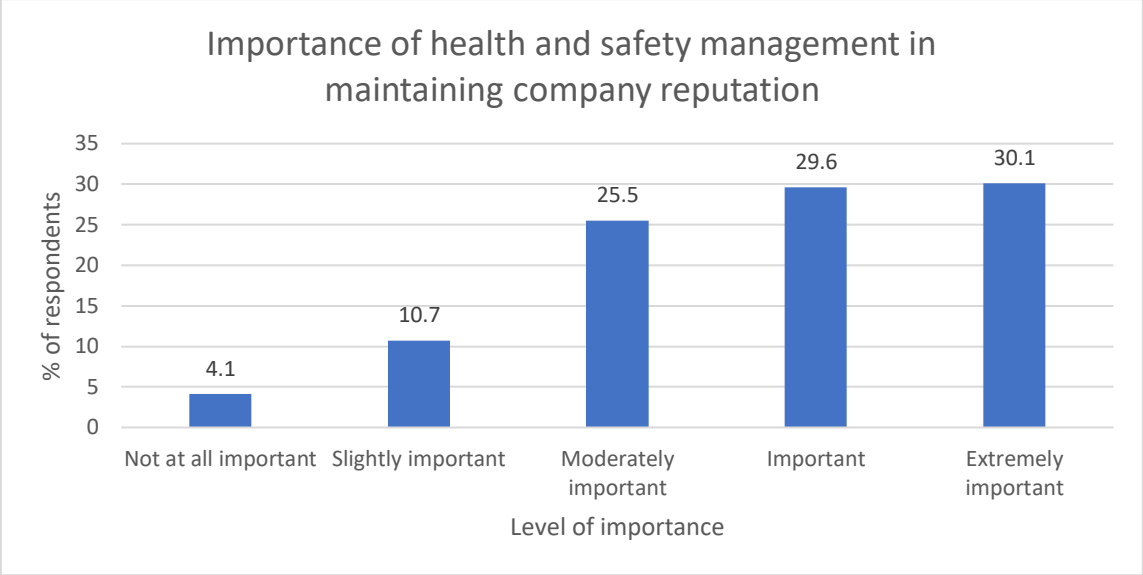

Figure 6.21: Importance of health and safety management in maintaining company reputation

The results from the literature suggests there is some kind of relationship between safety performance and reputation of companies (Chiang et al, 2017; Asanka and Ranasinghe, 2015; Jones et al., 2006). This research confirms the views from the literature and suggests that companies pursue health and safety as part of the need to improve reputation. Having a good reputation can translate into the ability to get work.

6.5.11 Importance of Health and Safety Management in Preventing Financial Loss

One of the key areas where health and safety management was deemed important according to the results was preventing financial loss. About 68% of the total respondents thought preventing financial loss to be either extremely important (33.3%) or important (34.4) in preventing financial loss to their companies. This comes from the realisation of the cost implication of health and safety issues on projects. About 25% of the respondents deemed health and safety management to be moderately important in preventing financial loss. The

remaining 8% of the respondents found health and safety management to be either slightly important or not important at all.

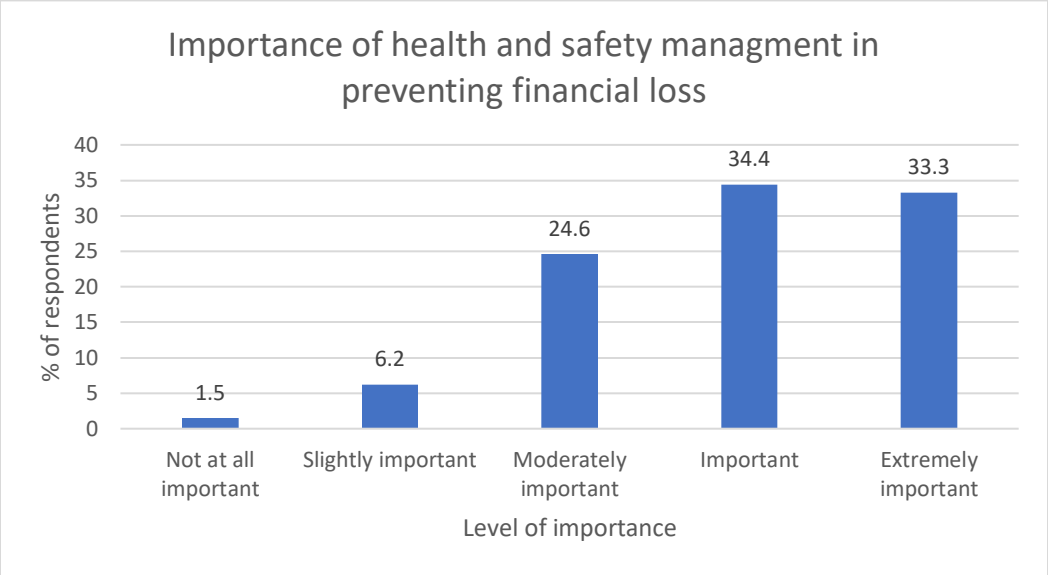

Figure 6.22: Importance of health and safety management in preventing financial loss

As one of the key requirements or measures of project success, many construction management measures are targeted at improving economic performance on projects. As presented in the literature, improved health and safety management should lead to improved cost performance by reducing financial loss as a result of accidents and poor performance (Everret and Frank, 1996; Dvir, 2005; Brace et al., 2009; Agwu, 2012; Banik, 2013). This research supports the view that better health and safety management practices lead to improved financial performance. This makes cost savings a major driver for improved safety performance on projects

6.5.12 Importance of Health and Safety Management in Raising the Loyalty of Workers to the Company

Respondents were also asked to indicate the extent to which they found health and safety management important in raising the loyalty of workers to the company. Figure 6.23 indicates that a little over 25% found health and safety management extremely important in increasing loyalty of workers. About 36.9% thought it very important. Overall 63% of the respondents found health and safety management policies playing an important role in raising loyalty of workers towards the company because they felt safer and protected. As high as 30% of the respondents deemed health and safety to be moderately important in raising employee loyalty, whereas the remaining 8% deemed it either slightly important or not important at all.

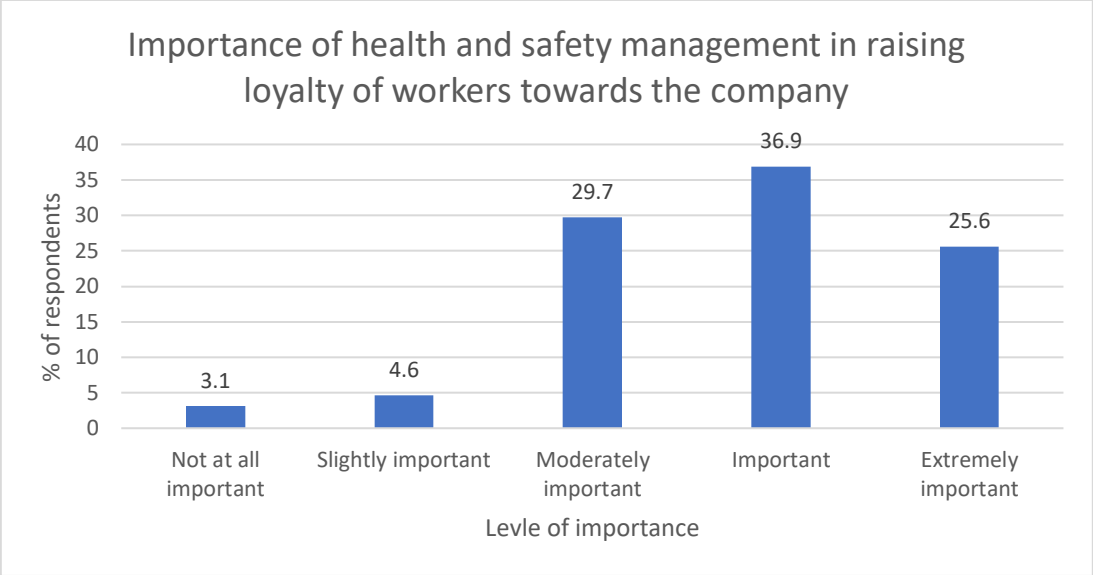

Figure 6.23: Importance of health and safety management in raising loyalty of workers to the company

This results introduces another important factor that drives health and safety efforts by construction companies. With the increasing need to improve performance on construction projects, it is important to ensure employees are loyal as this will motivate them to improve their productivity. The result of this research contributes to the literature on employee loyalty

by indicating that improved health and safety serves as a key means to ensure loyalty. Similar results are presented in other industries by researchers such as Tomic et al (2018), Sharma et al (2016), and Kumar and Pansari (2015),

6.5.13 Importance of Health and Safety Management in Preventing Delay to the Workflow

Of all the factors presented to the respondents, the most important factor when it came to health and safety management, was identified as the prevention of delay in workflow as a result of health and safety incidents. 72% of respondents suggested that good health and safety management was either extremely important (40.9%) or important (31.3%) in preventing delays in workflow on construction projects. 20% of respondents deemed health and safety management moderately important in preventing workflow delays. The remaining 8% were of the view that health and safety management was either slightly important or not important at all. This is shown in Figure 6.24.

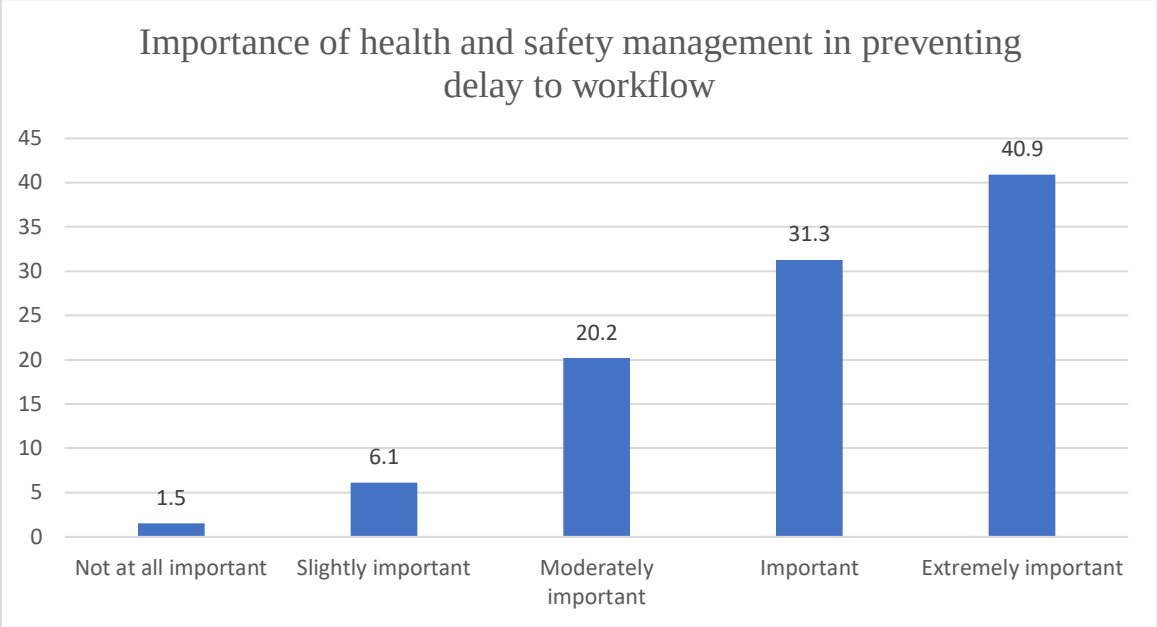

Figure 6.24: Importance of health and safety management in preventing delay to workflow

This result supports the view that providing the right conditions will lead to improved performance of workforce. Construction companies can improve their performance by ensuring the right conditions are presented on projects for site teams. With the Saudi Arabian construction industry performing poorly, the results from this research provides another important consideration for improving performance by improving the working conditions of workers. As reported in Thanwadee (2009); Walsh and Sawhney (2004); Sacks *et al.* (2009) accidents on sites lead to delays in construction projects. With delays in executing oil and gas construction projects as reported in Ruqaishi and Bashir (2015), this research suggests that improving health and safety performance

6.5.14 Importance of Health and Safety Management in Environmental Protection

The study also explored whether health and safety management practice came with any positive environmental impacts. 60% of the respondents agreed that health and safety

management was either extremely important (37.6%) or important (22.8%) in environmental protection. About 28% of respondents were of the view that health and safety management was only moderately important to the environmental protection. 12% were of the view that health and safety management was either slightly important (8.5%) or not important at all (3.7%) in this regard.

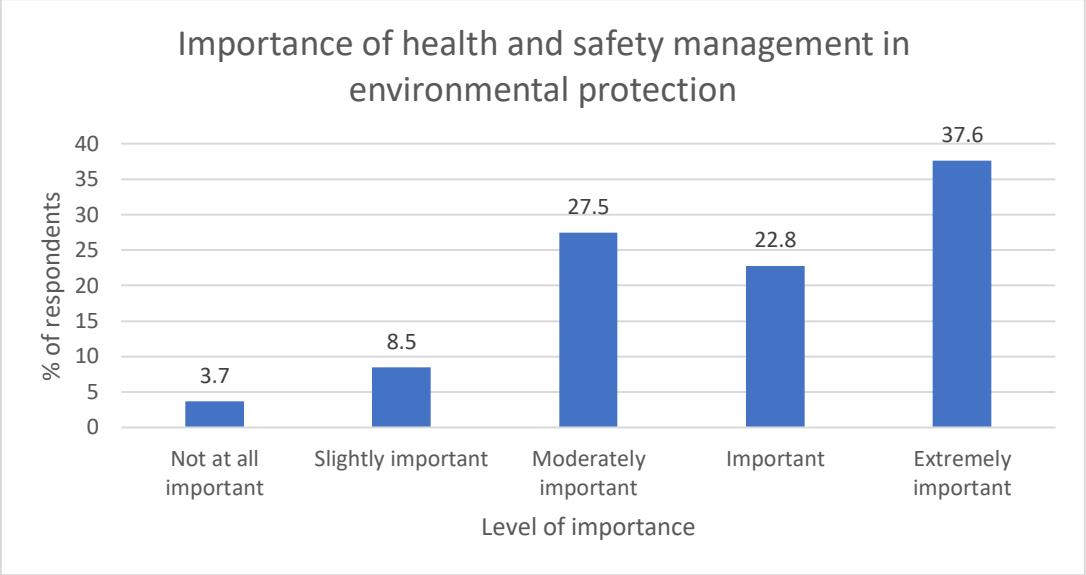

Figure 6.25: Importance of health and safety management in environmental protection

With the ever increasing attention to environmental management and protection, the results from this research suggests that one of the importance of health and safety management is the protection of the environment.

6.5.15 Importance of Health and Safety Management in Improving Client Satisfaction

Satisfying clients remains one of the key requirements of every construction organisation and this has an impact on almost every activity undertaken by the construction company. In this study, 64% found health and safety management to be either extremely important or important. While 24% of the respondents thought health and safety management to be moderately important. 12% of the respondents reported that health and safety management was only slightly important or not important at all in relation to satisfying the needs of the client.

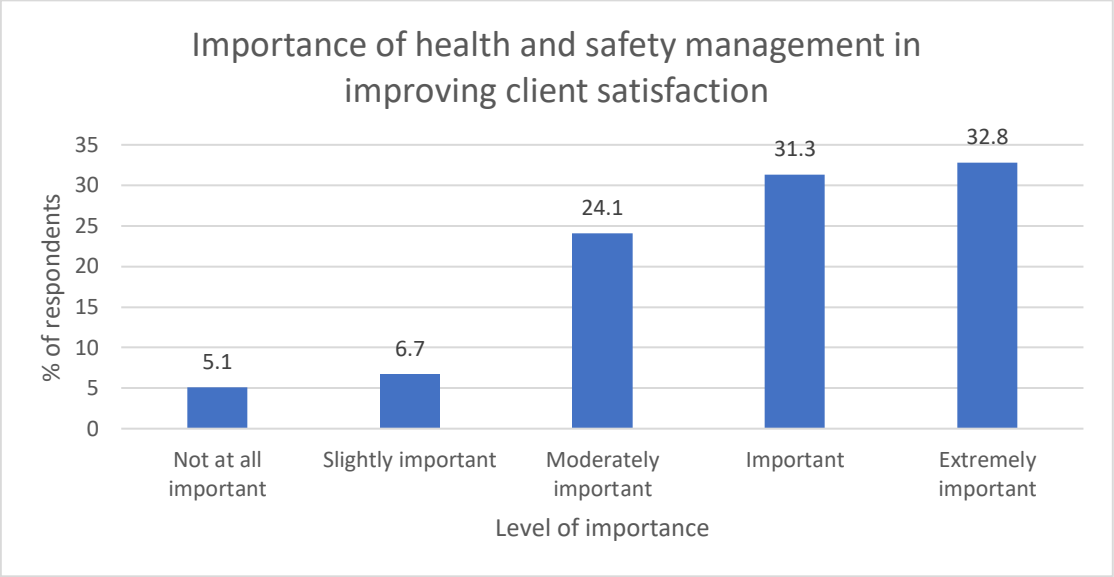

Figure 6.26: Importance of health and safety management in improving client satisfaction

With the need to meet the needs of the client being the most important requirement on construction projects, this research suggests that improving performance in terms of health and safety is a very important way to ensure clients are satisfied. Research by Wu et al (2016), Kvorning et al (2015) suggest that improved safety practices on construction sites can be linked to improved environmental protection.

6.5.16 Importance of Health and Safety Management in Raising Employee Awareness of Regulations and Safety Polices

One of the key aspects of health and safety management is to ensure that workforce is aware of the regulations and policies in place to meet the requirements 77% of the respondents found health and safety management critical in ensuring employees were aware of the legislative requirement. Only about 18.8% indicated that health and safety management was moderately important in raising employee awareness. The percentage of respondents who found health and safety management to be slightly important or not at all important was only 4%.

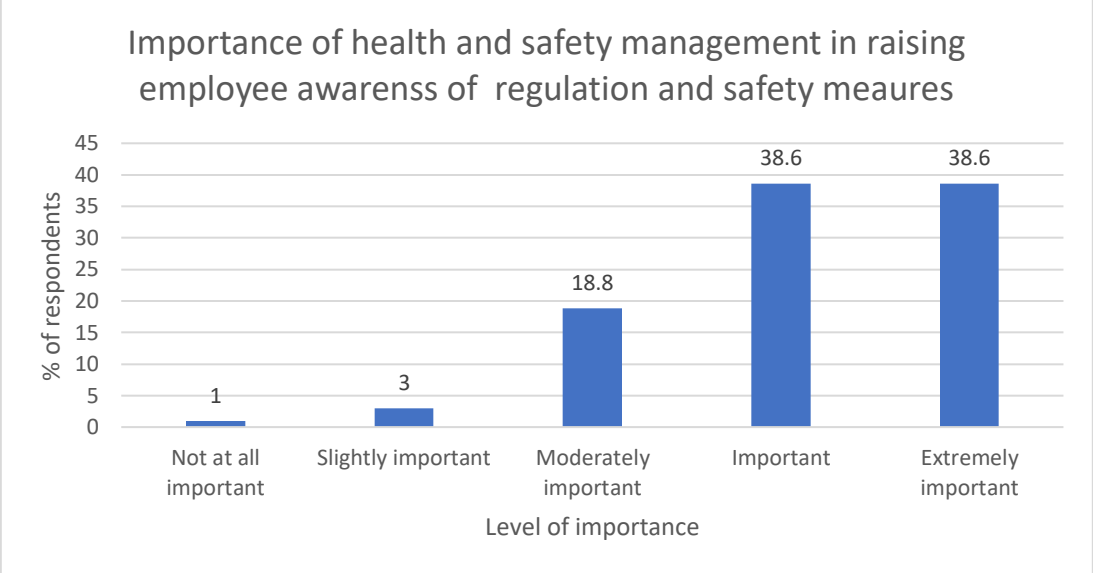

Figure 6.27: Importance of health and safety management in raising employee awareness of regulation and safety measures

The high agreement regarding the importance of safety management practices in raising employee awareness of safety supports the views of Pungvongsanuraks and Chinda (2010), Li et al (2015), and Fung et al (2015) who suggests that measures for improving safety should

lead to improved awareness of workers concerning safety management measures on construction projects.

6.5.17 Importance of Health and Safety Management in Demonstrating Employee Competence

The respondents were also asked to indicate the extent to which they found health and safety management important in demonstrating the competence of employees on projects. 73% of the respondents, found health and safety management to be critical in demonstrating employee competence. 38.6% in each case responded as extremely important and important respectively. Only about 19% of the respondents suggested that health and safety management was moderately important in demonstrating employee competence. 5.5% were of the view that it was only slightly important (4.5%) or not important at all (1%). The results indicate that for majority of this respondents of this research health and safety management helps to demonstrate competence. The literature suggests that safety knowledge demonstrates competence on the part of construction workforce (Fang and Wu, 2013; Guo et al., 2016; Park et al., 2016;). This indicates that to make employees more competent at their jobs, they should receive the adequate training on safety management.

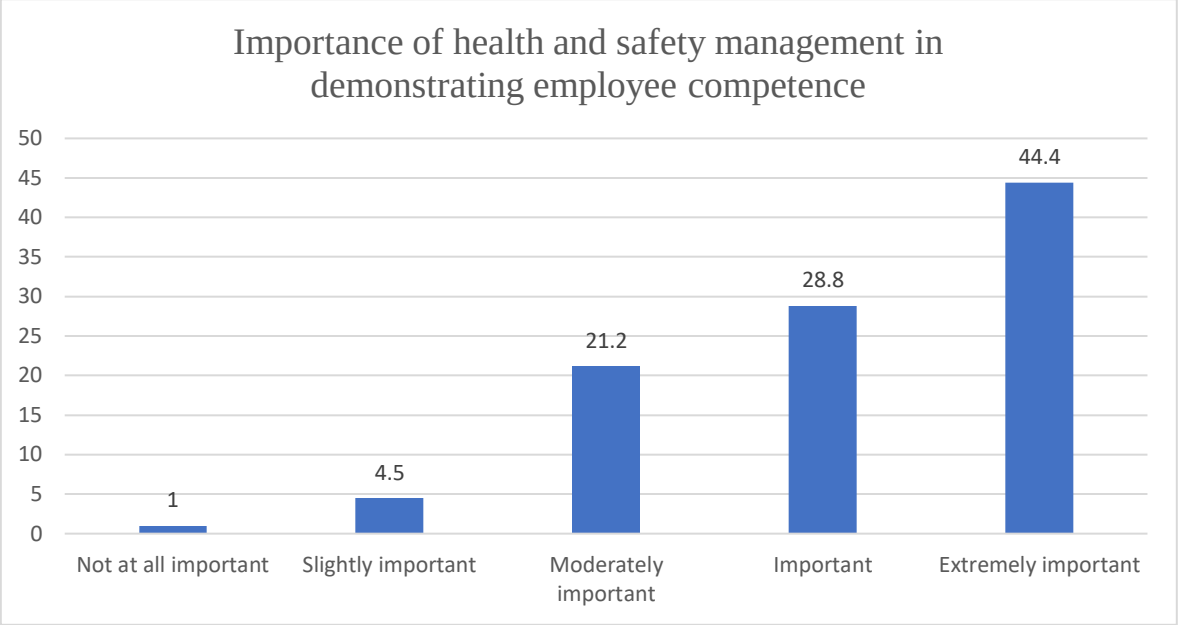

Figure 6.28 Importance of health and safety management in demonstrating employee competence

This clearly indicates that health and safety management is important to a very large extent in demonstrating employee competence.

6.5.18 Extent to Which Health and Safety Management Impacts on Welfares

As part of the questionnaire, respondents were asked to indicate the extent to which the health and safety management practices adopted in their companies impacted on the welfare of the employees within their companies. For the purposes of this research, employee welfare refers to the well-being, protection and interest of employees 42.3% of the respondents, thought health and safety management was extremely influential in ensuring employee welfare within their companies. 23% suggested that health and safety management was influential in ensuring employee welfare while 25% found health and safety management to be somewhat influential in relation to employee welfare.

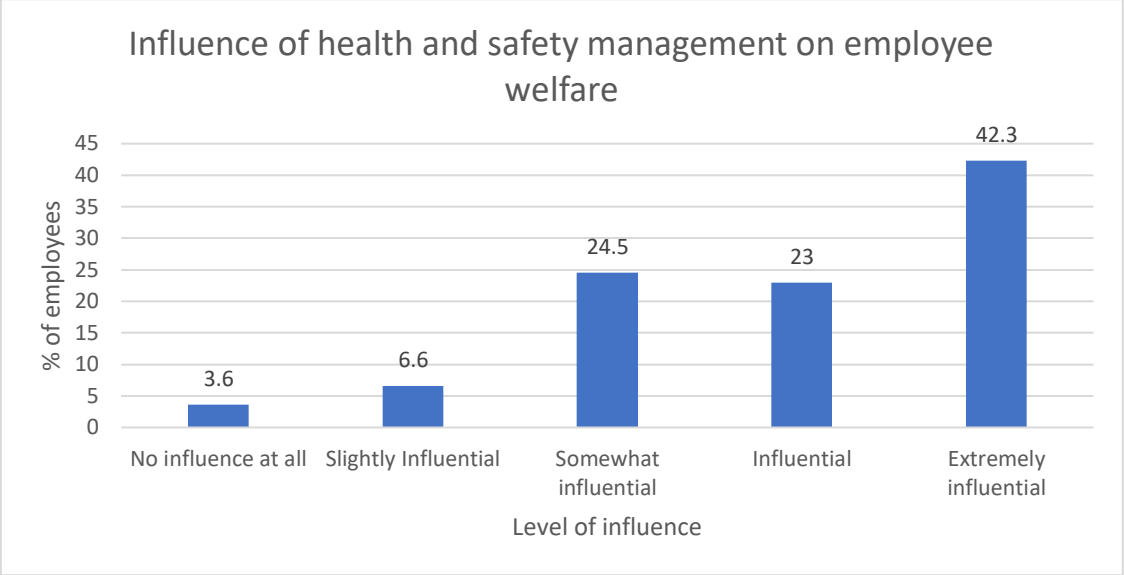

Figure 6.29: Extent to which health and safety management impacts on welfare of employees

10.2% were of the view that health and safety management was either slightly influential or had no influence at all on employee welfare. Figure 6.29 indicate that health and safety management is, to a large extent, influential in ensuring employee welfare.

As presented earlier, health and safety policies if well implemented can lead to improved working conditions making employees feel safe and protected when working on oil and gas construction projects. The results of this analysis compared to the other important factors for pursuing health and safety on construction projects indicates that improving employee welfare is not one of the key factors. This being said however, this research suggests that improving health and safety is a sure way to improve employee welfare and ensure they have better working conditions. The results support the views of Eghan (1998) and Bomel (2001) who suggest that health and safety management contributes to employee welfare on projects.

6.6 Measures towards Improving Health and Safety on Oil and Gas Construction Projects

Ten different measures identified in the literature were presented to the research participants to indicate the extent to which they were adopted in their companies to improve health and safety on their oil and gas construction projects. The results of these indicate that different measures are adopted in the different companies with the aim of improving health and safety on their projects. Through the use of the relative importance index (RII) calculation, the measures are ranked in terms of their popularity with the companies. The results are shown in Table 6.2.

Table 6.2: *Relative importance of measures adopted to improve health and safety*

MEASURES	**RELATIVE FREQUENCY OF MEASURES ADOPTED TO IMPROVE HEALTH AND SAFETY**							
	Weighting assigned on Likert scale (1 least adopted and 5 Most adopted) and frequencies					**TOTAL NUMBER OF RESPONDENTS**	**RII RELATIVE IMPORTANCE**	**RANK**
	1	**2**	**3**	**4**	**5**			
Planning and monitoring H&S implementation	3	23	52	50	60	188	0.750	8
Monitoring and improving the level of awareness concerning occupational H&S measures	11	10	55	63	59	198	0.751	7
Periodic investigation of any hazards or malfunction in machinery and equipment (risk assessment)	2	14	50	69	63	198	0.779	3
Commitment by employees and workers to health and safety programmes	9	14	52	67	56	198	0.748	9
Keeping in touch with the latest updates concerning H&S programmes	4	16	56	45	75	196	0.774	4
Proper collaboration between employees and H&S management	9	22	48	55	59	193	0.738	10
Attending seminars relating to H&S	13	18	37	57	69	194	0.756	6
Cooperation with governmental organisations in maintaining safety for employees and workers	5	15	41	67	70	198	0.784	2
Provision of adequate PPE for employees	11	8	45	54	80	198	0.786	1
Participating in determining the rules or programmes relating to H&S	3	17	54	55	69	198	0.772	5

According to table 6.2 above, different measures have been undertaken by the construction companies to improve health and safety on oil and gas construction projects. The most common of all the measures adopted was provision of personal protective equipment (PPE) to the employees. The general results indicated that all the parties involved in this research used PPE to ensure their employees were safe during the execution of oil and gas construction works.

This was followed by cooperation between companies and government organisations in maintaining the safety of their employees and workers. This measure was deemed very important due to the acceptance that government legislation had a key role to play in ensuring health and safety is achieved throughout the construction industry.

The third common approach or measure identified was risk assessment, in which the companies conducted periodic investigation of any hazards or malfunction in machinery and equipment. This helped the construction companies to identify the hazards which were likely to lead to health and safety incidents on their projects and to find ways of dealing with such hazards. The fourth most important measure was identified as 'keeping in touch with the latest updates concerning H&S programmes'. Considering the frequently changing nature of construction and the issues related to construction health and safety, it is important to always ensure that the companies were informed regarding latest updates. From the research data, it was identified that the companies taking part in this research used this as a way to help improve health and safety on their projects.

The fifth common practice was identified to be 'participating in determining the rules or programmes related to health and safety. This outcome was expected considering that

majority of the respondents were involved in the planning and formulation of health and safety measures and policies within their respective companies. This also indicates that companies pay attention to ensuring participation of their work force in planning for health and safety.

The least common measures identified were: Proper collaboration between employees and health and safety managers; commitment by employees and workers to health and safety programmes; and planning and monitoring health and safety implementation. These measures being unpopular can be linked to the poor performance of companies in term of health and safety in the Saudi Arabian construction industry. There were, however, other measures such as: monitoring and improving the level of awareness concerning occupational H&S measures; and attending health and safety seminars. Also these measures were also adopted by some of the companies, the results indicate that they are not in the top five measures adopted by the companies.

Compared to the literature in terms of measured implemented to improve health and safety on construction sites, there is a common theme of the need to improve on measures adopted for improving safety on construction sites (Hughes and Ferrett, 2012). As presented in Niu et el. (2019); and Inez et al. (2013), the use of PPE has become a primary measure to protect construction workers from the dangers on site. The results of this research confirms the use of PPE as a primary measure to improve health and safety. From the results, the use of PPE is the number one measure adopted in the Saudi Arabia oil and gas construction industry. The second most frequently used measure from this research relates to government legislation which Awwad et al (2016), Ganah and John (2015), and Manu et al., (2013) all report as very critical in

ensuring improvement in safety management practices. The results of this research therefore confirm that legislation still remains an important driver in the area of oil and gas construction projects.

6.7 Approach to Health and Safety Management and Education

This section presents results on the approach taken by the companies to manage health and safety on their oil and gas projects including education and training. The section specifically presents results on health and safety education; sources of knowledge and cultural perspectives.

6.7.1 Approach to Health and Safety Education

Different approaches can be taken to educate workforce on health and safety related issues. The respondents were provided with nine different approaches to health and safety education to indicate the extent to which these approaches are used in educating their workforce. The results shown in table 6.3 indicate that of all the different approaches to educating site teams, the most adopted was the use of safety mentors. The practice of using safety mentors ensured there were people on site or on projects who specifically helped teams to achieve best practices relating to health and safety. This was followed by orientation and training on site as a key way to educate site teams. This orientation ensured site teams received safety information on the job specific to projects there were undertaking.

Table 6.3 Approaches to health and safety education

Approach to H&S education	**EXTENT OF USE OF APPROACH TO HEALTH AND SAFETY MANAGEMENT EDUCATION**							
	Weighting assigned on Likert Scale (Extent of use 1 –least used – 5 most used) and frequencies					**TOTAL NUMBER OF RESPONDENTS**	**RII (RELATIVE IMPORTANCE**	**RANK**
	1	**2**	**3**	**4**	**5**			
Tool Box talks	9	7	59	48	70	184	0.769	3
Monthly bulletin	7	22	42	66	54	191	0.745	7
Online Education	11	13	53	45	67	189	0.752	5
Simulation and role play exercises	6	11	50	55	57	179	0.763	4
Orientation and trainings	4	12	50	65	58	189	0.770	2
Proprietary safety training videos and demonstrations	4	15	57	60	53	189	0.751	6
Use of safety mentors	2	13	53	41	81	190	0.796	1
Use of safety newsletters	12	20	50	49	61	192	0.732	8
Safety bulletin boards	8	20	68	36	61	193	0.726	9

Tool box talks were identified to be the third common approach to educating site teams on health and safety issues and measures to adopt to prevent accidents on sites. Simulations and role play exercises were identified as the fourth common means of educating site teams on the issues relating to health and safety on projects. Online education was identified to be the fifth common approach to health and safety education for the site teams. The least common approaches to education were identified as safety bulletin boards; use of safety newsletters; monthly bulletins; and use of proprietary safety training videos and demonstrations.

Different means to educate and train construction workers have been presented in the literature. Hallowell, (2012) reports that different means of sharing information through training programmes, committees, talks and bulletin boards should all be used for the purposes of health and safety. Urquhart (2011) on the other hand reports that training videos and live demonstrations are effective ways of sharing safety knowledge with site teams. Findings from this research support that need to adopt different means to share safety knowledge. Use of safety mentors which is ranked as the commonest means to achieve health and safety, according to the results of this research. From the literature, safety mentors are becoming a common and increasingly important in improving the awareness health and safety measures. Chen and Jin (2004), Wu et al (2017) and Gunduz and Ahsan (2018) all report that the use of safety mentors play a key role in passing on knowledge and training site teams. Orientations and trainings as well as tool box talks have been reported in the literature as the commonest means of training site teams (Olson et al., 2016; Anderson, 2017; Li et al., 2015).

6.7.2 Sources of Safety Knowledge

Respondents were also required to indicate the sources of knowledge they employed in educating their teams on health and safety related issues. The result shown in table 6.4 indicate that all the different sources of safety knowledge were adopted by the companies to ensure health and safety is achieved on their projects. Of the six sources of knowledge presented to the participants, accident analysis was identified as the most widely used source of information for safety training. This was followed by job hazard analysis which is closely related to accident analysis on projects. The third source of knowledge commonly used was the use of health and safety standards. These standards helped the companies to easily identify key requirements for health and safety. The fourth source was identified as having informal discussions with project teams. This was followed by group brainstorming. Self-inspection was the least used source of health and safety knowledge for training the workforce on health and safety related issues.

Table 6.4: Sources of safety knowledge

KNOWLEDGE SOURCES	EXTENT OF USE OF SOURCES OF HEALTH AND SAFETY KNOWLEDGE							
	Weighting assigned on Likert scale (1 least used source – 5 most used) and frequencies					TOTAL NUMBER OF RESPONDENTS	RII (RELATIVE INDEX)	RANK
	1	2	3	4	5			
Self-inspections	16	22	49	58	48	193	0.704	6
Group brainstorming	18	27	43	46	59	193	0.705	5
Accident analysis	4	10	44	54	78	190	0.802	1
Job hazard analysis	7	11	36	61	77	192	0.798	2
Informal discussions with project teams	8	16	37	62	69	192	0.775	4
Health and safety standards	6	13	43	56	74	192	0.786	3

The results on the sources of safety knowledge indicates that contractors working on oil and gas construction projects are mostly from live projects or experiences from projects. With two of the top three sources of knowledge coming from the construction projects the teams work on, it is evident that site teams will rely on information and experiences gathered from projects making their safety knowledge more practical and relatable. This perhaps presents a better approach to influence safety training. Halllowell (2012) presents similar results. Alasamri et al (2012) also report that both internal and external sources of safety knowledge are beneficial for improving safety knowledge.

6.7.3 Safety Culture in Construction Companies

Safety culture is reported to be very important in ensuring health and safety on construction projects and, most importantly, on oil and gas construction sector. This section presents results on the measures adopted by the companies to build and ensure that a safety culture is maintained at all times. The results is presented in table 6.5.

According to table 6.5 eight different measures were presented to the research respondents to indicate the extent to which such measures were adopted in achieving safety culture. The most commonly used measure was identified as safety behaviour sampling. This approach required companies sampling their employees from time to review their behaviour in relation to the safety requirements. Two further measures were joint second and these were holding safety meetings to allocate corrective work and developing safety avoidance strategies and designs. These two measures were identified as typical, as companies used these to ensure their clients understood the requirements for health and safety, and modified their behaviour to conform to such requirements.

The next common measure identified was management and workforce support for ownership of safety issues. This was identified as the fourth most important measure for companies as it helped them to put people in charge of health and safety with the correct support in place.

Table 6.5: Measures to achieve safety on projects

MEASURES TO ENSURE SAFETY CULTURE	EXTENT OF USE OF PRACTICES							
	Weighting assigned on Likert scale (1 least important – 5 very important) and frequencies					TOTAL NUMBER OF RESPONDENTS	RII (RELATIVE INDEX)	RANK
	1	2	3	4	5			
Safety Behaviour sampling	4	19	43	47	68	181	0.772	1
Management and workforce support and ownership of safety issues	7	17	39	66	60	189	0.764	4
Use of safety behavioural checklist	10	18	48	69	48	193	0.732	7
Modifying workforce environment	7	19	44	67	52	189	0.746	6
Weekly safety inspection plan	8	32	41	46	63	190	0.731	8
Monitor safety performance and review safety checklist	8	16	47	60	59	190	0.754	5
Hold safety meetings and allocate corrective work	4	19	49	52	69	193	0.769	2
Develop safety avoidance strategies and design feedback	7	17	41	62	66	193	0.769	2

This was followed by monitoring safety performance and reviewing checklist to ensure that safety culture was built by the companies. Performance reviews provide the companies with the opportunity to check safety behaviour and ensure best measures are put in place to develop the required culture.

The three least common measures adopted by the companies to ensure safety culture were identified as: modification of working environment; use of safety behavioural checklists and

the use of weekly safety inspection plan. The results indicate that although these measures are also used to some extent, they are not extensively used on their projects.

Having the right safety culture will influence the attitudes and perceptions of construction site workers leading to improved attention to safety issues. The results of this research indicates that behaviour sampling and meetings as well as processes to receive feedback from the site teams are used as the main means to measure safety culture. Although these practices are good in capturing safety culture, the best means of capturing safety culture which is inspections on sites is regarded as the least used method to achieve safety on site. As presented in Alasamri et al (2012) approaches to safety behaviour should target culture on sites.

6.8 Barriers to Achieving Health and Safety Management

Although different measures are adopted by the companies to achieve safety on oil and gas construction projects, there are a number of factors that serve as barriers thereby preventing some KSA companies from achieving their targets. This section presents results on the key barriers identified from the responses as shown in table 6.6.

Table 6.6: Barriers to achieving health and safety during construction projects

BARRIERS	EXTENT OF INFLUENCE OF BARRIERS TO ACHIEVING HEALTH AND SAFETY							
	Weighting assigned on Likert scale (1 lowest – 5 highest) and frequencies					TOTAL NO. OF RESPONDENTS	RII (RELATIVE INDEX)	OVERALL RANKING
	1	2	3	4	5			
Uncertainty over the roles of parties towards safety management	2	19	43	63	64	191	0.776	7
Lack of adequate training	1	10	21	80	80	192	0.838	2
Poor attitude of staff towards health and safety	2	10	18	68	81	179	0.841	1
Lack of consistent business support policy	2	12	33	60	82	189	0.820	4
Lack of effective participation by management	2	13	28	67	76	186	0.817	5
Lack of financial resources	8	14	27	64	75	188	0.796	6
Non definition of occupational health and safety (OHS) as one of company's strategic objectives	10	9	53	63	55	190	0.752	8
Lack of strategic vision for health and safety	6	11	22	59	94	192	0.833	3

According to Table 6.6, of all the eight barriers identified, poor attitude of staff towards health and safety was identified as the main barrier. That lack of adequate training on health and safety was the second biggest barrier to achieving the desired objectives during oil and gas construction projects in the companies. This makes educational training very important considering that it can affect attitudes and level of health and safety knowledge. The third critical barrier to achieving health and safety was identified as lack of strategic vision for health and safety in the companies. It acts as a barrier because it leads to lack of support for health and safety practise in the companies. The fourth critical barrier was identified as a lack of consistent business support policy. This barrier relates closely to the third barrier which concerns the lack of strategic vision to support health and safety. This is the reason for a lack of consistent business support policy for health and safety. The fifth barrier was identified as a lack of effective participation by management in ensuring health and safety is achieved on construction projects. It can be seen that of all the five most critical barriers to achieving health and safety practise, employees as well as management have very a critical role to play.

The other factors identified as barriers to achieving health and safety on construction projects include: lack of financial resources; uncertainty over the roles of parties towards safety management; and non-definition of occupational health and safety (OHS) as one of company's strategic objectives. These factors further indicate the critical role played by management and strategic decision takers in the companies in relation to health and safety. It appears all factors identified in the literature serve as barriers to achieving health and safety within the researched KSA companies. The critical factors identified here suggest there is a lot that can be done by the construction companies to achieve health and safety in their companies.

The results on barriers to achieving health and safety on construction projects confirm the common findings in literature which suggest that many factors are responsible for preventing the achievement of health and safety plans or measures. As shown in this research, attitudes remain the key barriers to health and safety. Similar results are presented Jannadi and Assaf (1998), Ismail et al (2012), Pungvongsanuraks and Chinda (2010), Brace et al (2009). The results of this research indicates that not only do attitudes influence health and safety on site, and the lack of adequate training for site teams. Considering the importance on safety training on project sites, having inadequate training could lead to poor performance.

6.9 Inferential Statistics

This section of the data analysis presents the data analysis using inferential statistical tools such as cross tabulation and correlation. Due to the nature and type of data gathered, the Spearman's correlation was deemed appropriate to find the relationships between the different variables of the data.

6.9.1 Correlations between Research Variables

All the research variables were correlated to determine the relationship between the different variables studied for this research. This section provides information on the significant correlations identified from the analysis.

6.9.1.1 Correlation between Size of Organisations and Research Variables.

The first set of correlation was to determine the relationship between the size of organisations the respondents work for and the different variables of the research. The results indicate that

there was a negative correlation between the size of organizations and the majority of the variables used for this research. Shown in Table 6.7, there were negative but weak correlation between the size of organisations and key variables such as: the extent of involvement in the formulation of health and safety policies; contribution of policy to health and safety; views on effectiveness of legislation; tailoring of practices to meet the demands of oil and gas projects; the influence of measures for meeting the demands of oil and gas construction projects and the extent to which health and safety policies impact on welfare.

The results indicate that for issues such as extent of involvement in formulating health and safety policies, the correlation suggests that for bigger organisations, there were less people involved in the formulation of health and safety policies compared to smaller organisations where more people took part in formulating policies. Similar results are presented for the remaining variables shown in the Table 6.7.

Table 6.7: Correlation between size of company and research variables

Correlations

		Size of Organisation	Extent of Involvement in Health and Safety Policies	Contribution of Policy to Health and Safety	Effectiveness of Legislation	Tailoring of Practices to Meet Demands of Oil and Gas Projects	Influence of Measures for Meeting Demands of Oil and Gas Projects	Extent to Which Health and Safety Policies Impact on Welfare
Size of Organisation	Pearson Correlation	1	-.193**	-.274**	-.195**	-.245**	-.224**	-.213**
	Sig. (2-tailed)		.006	.000	.006	.000	.002	.003
	N	199	199	199	198	198	197	195
Extent of Involvement in Health and Safety Policies	Pearson Correlation	-.193**	1	.530**	.290**	.406**	.335**	.298**
	Sig. (2-tailed)	.006		.000	.000	.000	.000	.000
	N	199	200	200	199	199	198	196
Contribution of Policy to Health and Safety	Pearson Correlation	-.274**	.530**	1	.446**	.617**	.484**	.535**
	Sig. (2-tailed)	.000	.000		.000	.000	.000	.000
	N	199	200	200	199	199	198	196
Effectiveness of Legislation	Pearson Correlation	-.195**	.290**	.446**	1	.500**	.415**	.311**
	Sig. (2-tailed)	.006	.000	.000		.000	.000	.000
	N	198	199	199	199	199	198	195
Tailoring of Practices to Meet Demands of Oil and Gas Projects	Pearson Correlation	-.245**	.406**	.617**	.500**	1	.486**	.526**
	Sig. (2-tailed)	.000	.000	.000	.000		.000	.000
	N	198	199	199	199	199	198	195
Influence of Measures for Meeting Demands of Oil and Gas Projects	Pearson Correlation	-.224**	.335**	.484**	.415**	.486**	1	.321**
	Sig. (2-tailed)	.002	.000	.000	.000	.000		.000
	N	197	198	198	198	198	198	194
Extent to Which Health and Safety Policies Impact on Welfare	Pearson Correlation	-.213**	.298**	.535**	.311**	.526**	.321**	1
	Sig. (2-tailed)	.003	.000	.000	.000	.000	.000	
	N	195	196	196	195	195	194	196

**. Correlation is significant at the 0.01 level (2-tailed).

6.9.1.2 Correlations between Experience of Respondents and Views on the Barriers to Achieving Health and Safety

Correlations were run between the experience of research participants and the key barriers to achieving health and safety on oil and gas construction firms. The results indicate that of all the critical barriers that prevent the achievement of safety on construction projects, only a lack of adequate training was found to correlate to the years of experience in the industry. The Spearman correlation indicates a positive but slightly weak correlation between the years of experience in the industry and the views on lack of adequate training as a barrier to achieving health and safety on oil and gas construction companies. This suggests that people with more experience in the industry have the perception that lack of adequate training is a key barrier to achieving health and safety on projects.

Table 6.8: Correlation between experience and barriers to health and safety management

Correlations

			Years of Experience	Poor attitude of staff towards health and safety as a barrier to Saftey Management	Lack of adequate training as a barrier to Saftey Management	Lack of strategic visions for health and safety as a barrier to Saftey Management	Lack of consistent business support policy as a barrier to Saftey Management	Lack of effective participation by management as a barrier to Saftey Management
Spearman's rho	Years of Experience	Correlation Coefficient	1.000	.058	.213**	-.015	.123	.045
		Sig. (2-tailed)	.	.438	.003	.838	.092	.545
		N	199	179	191	191	188	185
	Poor attitude of staff towards health and safety as a barrier to Saftey Management	Correlation Coefficient	.058	1.000	.410**	.065	.433**	.364**
		Sig. (2-tailed)	.438	.	.000	.390	.000	.000
		N	179	179	179	179	176	173
	Lack of adequate training as a barrier to Saftey Management	Correlation Coefficient	.213**	.410**	1.000	.288**	.330**	.422**
		Sig. (2-tailed)	.003	.000	.	.000	.000	.000
		N	191	179	192	192	189	186
	Lack of strategic visions for health and safety as a barrier to Saftey Management	Correlation Coefficient	-.015	.065	.288**	1.000	.231**	.287**
		Sig. (2-tailed)	.838	.390	.000	.	.001	.000
		N	191	179	192	192	189	186
	Lack of consistent business support policy as a barrier to Saftey Management	Correlation Coefficient	.123	.433**	.330**	.231**	1.000	.362**
		Sig. (2-tailed)	.092	.000	.000	.001	.	.000
		N	188	176	189	189	189	183
	Lack of effective participation by management as a barrier to Saftey Management	Correlation Coefficient	.045	.364**	.422**	.287**	.362**	1.000
		Sig. (2-tailed)	.545	.000	.000	.000	.000	.
		N	185	173	186	186	183	186

**. Correlation is significant at the 0.01 level (2-tailed).

6.9.1.3 Correlation between Size of Company and Methods Adopted to Educate Staff on Health and Safety

This correlation sought to investigate whether there was a relationship between the size of a company (in terms of number of employees) and the choice of education for health and safety. The results are shown in table 6.9 demonstrates that size of organization had no correlation with the top five identified means of training except the use of tool box talks. The results suggest a positive but weak correlation between the size of the company and their use of tool box talks as a means of training. This suggests that tool box talks become popular as the number of workers in the company increases therefore, larger organisations use tool box talks more than smaller organisations.

Table 6.9: Correlation between number of workers in organisation and choice of health and safety educational training

Correlations

			Number of Workers in Organisation	Use of Safety Mentors	Orientation and trainings	Tool Box Talks	Simulation and role play exercises	Online Education
Spearman's rho	Number of Workers in Organisation	Correlation Coefficient	1.000	.087	.053	.215**	.069	.142
		Sig. (2-tailed)	.	.236	.466	.003	.361	.052
		N	199	189	188	192	178	188
	Use of Safety Mentors	Correlation Coefficient	.087	1.000	.236**	.368**	.296**	.366**
		Sig. (2-tailed)	.236	.	.001	.000	.000	.000
		N	189	190	187	190	177	186
	Orientation and trainings	Correlation Coefficient	.053	.236**	1.000	.303**	.390**	.404**
		Sig. (2-tailed)	.466	.001	.	.000	.000	.000
		N	188	187	189	189	176	185
	Tool Box Talks	Correlation Coefficient	.215**	.368**	.303**	1.000	.344**	.458**
		Sig. (2-tailed)	.003	.000	.000	.	.000	.000
		N	192	190	189	193	179	189
	Simulation and role play exercises	Correlation Coefficient	.069	.296**	.390**	.344**	1.000	.312**
		Sig. (2-tailed)	.361	.000	.000	.000	.	.000
		N	178	177	176	179	179	175
	Online Education	Correlation Coefficient	.142	.366**	.404**	.458**	.312**	1.000
		Sig. (2-tailed)	.052	.000	.000	.000	.000	.
		N	188	186	185	189	175	189

**. Correlation is significant at the 0.01 level (2-tailed).

6.9.1.4 Correlation between Size of Organisation and the Sources of Knowledge for Health and Safety Training

The research performed correlation between the size of organization in terms of number of employees and the different sources of knowledge for health and safety education in the companies. The results shown in table 6.10 suggest that the number of workers in the organization had a positive but weak correlation with three main sources of knowledge: self-inspections; health and safety standards; and job hazard analysis in order of decreasing strength.

This indicates that although the correlation is weak, as the number of employees increase, the use of self-inspections, health and safety standards and job hazard analysis also increases. There were no significant correlations between the size of the organization and the other sources of knowledge for health and safety training.

This indicates that although the correlation is weak, as the number of employees increase, the use of self-inspections, health and safety standards and job hazard analysis also increases. There were no significant correlations between the size of the organization and the other sources of knowledge for health and safety training. Considering the resource implication health and safety measures, bigger companies are expected to have more resources and ultimately lead to improved performance. For example, bigger companies can subscribe to external professional bodies to receive safety bulletins or conduct periodic safety inspections.

Table 6.10: Correlation between number of people in organisation and sources of information for safety training

Correlations

			Number of Workers in Organisation	Accident Analysis	Job Hazard Analysis	Health and Safety Standards	Informal Discussion with Project Teams	Group Brainstorming	Self-inspections
Spearman's rho	Number of Workers in Organisation	Correlation Coefficient	1.000	.119	.177*	.189**	.063	.107	.191**
		Sig. (2-tailed)	.	.103	.015	.009	.390	.140	.008
		N	199	189	191	191	191	192	192
	Accident Analysis	Correlation Coefficient	.119	1.000	.636**	.402**	.459**	.577**	.486**
		Sig. (2-tailed)	.103	.	.000	.000	.000	.000	.000
		N	189	190	189	189	189	190	190
	Job Hazard Analysis	Correlation Coefficient	.177*	.636**	1.000	.545**	.555**	.542**	.481**
		Sig. (2-tailed)	.015	.000	.	.000	.000	.000	.000
		N	191	189	192	191	191	192	192
	Health and Safety Standards	Correlation Coefficient	.189**	.402**	.545**	1.000	.591**	.427**	.421**
		Sig. (2-tailed)	.009	.000	.000	.	.000	.000	.000
		N	191	189	191	192	191	192	192
	Informal Discussion with Project Teams	Correlation Coefficient	.063	.459**	.555**	.591**	1.000	.467**	.488**
		Sig. (2-tailed)	.390	.000	.000	.000	.	.000	.000
		N	191	189	191	191	192	192	192
	Group Brainstorming	Correlation Coefficient	.107	.577**	.542**	.427**	.467**	1.000	.681**
		Sig. (2-tailed)	.140	.000	.000	.000	.000	.	.000
		N	192	190	192	192	192	193	193
	Self-inspections	Correlation Coefficient	.191**	.486**	.481**	.421**	.488**	.681**	1.000
		Sig. (2-tailed)	.008	.000	.000	.000	.000	.000	.
		N	192	190	192	192	192	193	193

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

6.9.1.5 Correlation between Size of Organisation and the Methods for Building Safety Culture

Correlation analysis were conducted between the size of organization in terms of the number of workers and the different means adopted to build safety culture in the organisations. Out of the five most frequently used methods for building safety culture, i.e. safety behaviour sampling; holding safety meetings and allocating corrective work; developing safety avoidance strategies; management and workforce support and ownership of issues; and monitoring of safety performance and review of safety checklist, it was identified that positive but weak correlations exist between the number of workers in the organization and all the variables with the exception of monitoring safety performance and review of the safety checklist. This suggests that for all other variables, the methods are more popular as the size of the firm increases.

The results suggest that the size of a construction company plays a key role in terms of the health and safety measures implemented on their projects. This is similar to conclusions by Liaudanskienė et al (2016) and, Schwatka and Rosecrance (2016) who suggest that the size of a construction company does not only influence the resources at their disposal to manage waste but also influences their perception of safety climate and ultimately their measures towards improving or achieving safety measures. The results indicate that where the company sizes are bigger, the level of involvement of management is high which can lead to improvement in safety practices. Langford et al., (2000) suggests that where management are heavily involved, there is better health and safety performance

Table 6.11: Correlation between number of workers in organisations and approaches taken to develop safety culture

Correlations

			Number of Workers in Organisation	Safety Behaviour Sampling	Hold safety meetings and allocate corrective work	Safety Avoidance Strategies and Design Feedback	Management and workforce support and ownership of safety issues	Monitor safety performance and review safety checklist
Spearman's rho	Number of Workers in Organisation	Correlation Coefficient	1.000	.184*	.142*	.172*	.148*	.129
		Sig. (2-tailed)	.	.013	.049	.017	.043	.076
		N	199	180	192	193	188	189
	Safety Behaviour Sampling	Correlation Coefficient	.184*	1.000	.562**	.451**	.577**	.524**
		Sig. (2-tailed)	.013	.	.000	.000	.000	.000
		N	180	181	180	181	176	179
	Hold safety meetings and allocate corrective work	Correlation Coefficient	.142*	.562**	1.000	.647**	.579**	.601**
		Sig. (2-tailed)	.049	.000	.	.000	.000	.000
		N	192	180	193	193	188	189
	Safety Avoidance Strategies and Design Feedback	Correlation Coefficient	.172*	.451**	.647**	1.000	.486**	.519**
		Sig. (2-tailed)	.017	.000	.000	.	.000	.000
		N	193	181	193	194	189	190
	Management and workforce support and ownership of safety issues	Correlation Coefficient	.148*	.577**	.579**	.486**	1.000	.521**
		Sig. (2-tailed)	.043	.000	.000	.000	.	.000
		N	188	176	188	189	189	185
	Monitor safety performance and review safety checklist	Correlation Coefficient	.129	.524**	.601**	.519**	.521**	1.000
		Sig. (2-tailed)	.076	.000	.000	.000	.000	.
		N	189	179	189	190	185	190

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

6.10 Summary of Chapter 6

This chapter has presented the results of the quantitative data gathered by construction companies involved in the delivery of oil and gas projects. A total of 200 respondents provided their views on the nature of oil and gas construction projects, the level of risks associated, the management of health and safety on oil and gas construction sites, the benefits and the barriers to achieving health and safety on oil and gas construction projects. The results presented in this chapter indicates that there are high levels of risks involved with oil and construction projects, and there is a need for better management of health and safety on oil and gas on construction projects.

The research results indicate that the level of involvement of site teams in the planning for health and safety for oil and gas construction projects is low. There was also generally, a low level of familiarity with policies and measures designed to improve health and safety on oil and gas construction projects due to the low level of involvement in the planning and design of such policies. The approach to health and safety was identified to be mainly through the use of mentors, orientation and training of site staff, tool box talks, and simulation and role play exercises among others.

Although implementing health and safety management on oil and gas construction projects come with benefits, there ae key barriers such as: poor attitude of staff towards health and safety ,a lack of adequate training, a lack of strategic vision for health and safety, lack of consistent business support policy and a lack of effective participation by management. These were identified as hindering the achievement of these benefits.

Based on the outcome of the analytical process, the next chapter develops a best practice framework for improving health and safety on oil and gas construction projects.

CHAPTER SEVEN: DEVELOPMENT OF A FRAMEWORK FOR HEALTH AND SAFETY MANAGEMENT

7.1 Introduction to Chapter Seven

From the data collection and analysis presented in the previous chapters, there is a clear indication that health and safety management is a major problem for the oil and gas companies in Saudi Arabia. There is a need to find a lasting solution to the problem by developing strategies that can be applicable to the situation in the country, taking into consideration the context and outcome of the data collected from the industry.

The fifth objective of this research is: *to develop a framework that can help construction health and safety managers to focus their priorities on factors that will significantly reduce accidents on construction sites*. Achieving this means drawing on the results from this research to ensure an applicable framework for construction in the Saudi Arabian oil and gas industry. As reported in Hughes and Ferrett (2012), there is a need for specialist health and safety training in the construction industry. The complicated and high risky nature of the oil and gas industry increases the need for this specialist training.

This chapter discusses the development of a framework to improve health and safety in the Saudi Arabian oil and gas industry. The framework is expected to serve as a guide to oil and gas companies on the best approach to health and safety in their activities and processes. The chapter is divided into three main sections: the key requirements for a framework for health and safety; discussion of the results in relation to requirements for a best practice framework and the framework and guide to using it.

7.2 Development of a Best Practice Framework for Health and Safety Management in Oil and Gas Construction Projects

The idea of a best practice framework is to achieve a set goal or objective. Hence the framework for health and safety management for construction projects in the oil and gas sector, as discussed in this section, considers the best approach to ensure that health and safety is properly adopted by construction firms working for oil and gas companies. Haadir and Panuwatwanich (2011), confirmed that there is a low level of health and safety practice during the execution of oil and gas projects. The literature suggests that there are many factors responsible for this current low level of health and safety management in construction projects for the oil and gas sector.

According to the literature in chapter 2, a conceptual framework was produced in chapter 3 which served as the basis to collect data on this research, The key components of the conceptual framework areas are policy formulation on the part of construction companies, elements of culture and safety management behaviour, safety knowledge and training, government legislation, monitoring of safety behaviour, feedback and audit of safety management practices, the need for corrective action, and the need for a periodic review of safety management and continual improvement (see chapter 3, section 3.3.1 for a detailed explanation of these components).

According to data analysis provided in the two previous chapters (chapter 5 on qualitative data analysis and chapter 6 on quantitative data analysis), it was evident that a best practice framework was required to ensure the improvement of health and safety management on oil and gas construction projects in Saudi Arabia. In developing the framework, the following key areas were put into consideration, the current state of health and safety performance on oil and gas construction projects in Saudi Arabia (based on the

outcome of this research). A framework produced in this chapter and the extant literature on the health and safety management of oil and gas construction projects. The current stage of health and safety within the construction projects in the oil and gas sector, as captured by the research, will be discussed to identify the key components needed for the development of this framework.

7.3 Current Health and Safety Performance for Oil and Gas Construction projects in Saudi Arabia

The results from this research present a number of implications for construction activities within the health and safety sector in Saudi Arabia. The results from the quantitative and qualitative data analysis indicate a number of key issues:

- There is a low level of participation in the development of health and safety measures and policies in the oil and gas industry. This outcome was identified from both the qualitative and quantitative phase of the study which shows that, although there was the general realisation and acceptance of involvement of different parties in formulating and designing health and safety management for oil and gas construction projects, for majority of the research participants, health and safety policies predominantly remained the preserve of higher level management. Key staff who were affected by health and safety issues and may have first-hand experience but do not usually feature in its planning and developing stages. There is a need, therefore, to involve all parties in the development of a best practice health and safety management framework.
- Construction projects in the oil and gas industry come with high levels of risk and danger which have to be taken into account by all relevant parties. In the Saudi Arabian construction industry, different oil and gas construction projects

come with a high level of safety risk compared to other construction projects. The nature of the projects makes it essential to improve health and safety measures specific to the industry.

- Occupational health and safety measures are not followed by many companies in the industry. A key outcome from this research is that, although different measures, including government legislation, are designed to deal with health and safety issues in oil and gas construction projects, these measures are not usually taken into account or adhered to during the execution of oil and gas construction projects.
- Poor management and the enforcement of PPE use during project management in construction within the oil and gas sector. Through interviewing relevant stakeholders it was found that the use of PPE, which was expected to be a first line measure against health and safety related issues during construction projects, was not usually enforced, leaving workers exposed to accidents and diseases. Considering the fundamental nature of PPE, this research has considered proactive attempts to educate and increase the awareness of site staff on the importance of PPE.

7.4 Components of the Best Practice Framework on Health and Safety in Oil and Gas construction projects

In developing the best practice framework for health and safety management within the oil and gas sector, there are a number of very important measures or components that must be taken into consideration. These components, which are discussed in this section, are adapted from Hughes and Ferrett (2012) and include, policy, organising, planning,

measuring, audit, and performance review. These components are developed in relation to the results of this research and the extant literature on health and safety management within the construction industry in Saudi Arabia. To make the framework more relevant to industry, aspects of health and safety related to oil and gas operations have been used to improve the applicability of the framework.

7.4.1 Building a Foundation for Health and Safety

According to Barnett (2013), a foundation serves as the basis to strengthen and uphold the various elements of any system. Just as the foundation of a building or other structure serves to ensure the integrity of that structure, the foundation for health and safety within construction companies, especially those working in the oil and gas sector, will ensure that the right approach to health and safety is developed. Developing that foundation, therefore, comes from a better understanding of the scope and nature of health and safety within the sector (Hughes and Ferrett, 2012).

Establishing the foundation is based on the perspective from which management within the company sees health and safety as well as the level of importance attached to the process. Zeng et al., (2008) are of the opinion that some organisations actively seek effective safety management systems, and this comes from their perspective on the importance of such systems in improving their activities. From the results of this research, Lingard and Rowlinson (2005) report that as part of the foundations for health and safety management, there should be a fundamental regulatory prescription which helps to clarify for the participants or industry players the key requirements regarding health and safety. For construction projects within the oil and gas sector, such a foundation will require not just a prescriptive framework from legislators, but also a better understanding of such requirements and their importance for the industry, the companies and their workers.

Choudhry et al., (2007) suggest there is a need for cultural change, to ensure a safety culture is created. Safety culture in an organisation can be defined as the product of individual and group values, attitudes, perceptions, competencies, and patterns of behaviour that determine the commitment to and the style and proficiency of an organisation's health and safety management. Building a foundation that helps to create a safety culture can be seen as a whole company direction and not just from the management position.

The need for a safety culture leads to the second element of the framework, which considers the need for a health and safety policy within the companies. Reiman and Oedewald (2004) suggest that organisational culture refers to values, norms and underlying assumptions forming over time during the company history affecting all the company's activities and in turn affected by them.

7.4.2 Policy for Health and Safety

The term 'policy' relates to the regulatory framework for construction companies. It refers to the health and safety of workers as well as conducting safe processes during the execution of projects. The essence of the policy is to ensure a safety climate (Cooper 2000, Choudhry and Fang, 2005) and is created for the activities of the companies. Policy for systematic management of health and safety at the corporate level ensures that strategic direction is created for health and safety management for all activities of the company. Data presented in this research suggests that even though the subject of health and safety and its management is of utmost importance, there is a low awareness of the policies among workers within the industry. Awareness of such policies is very low, especially within SMEs, placing employees at risk especially during construction projects. Health and safety policy should target the creation of a culture which becomes

a way of life for all stakeholders. Qualitative data collected for this study confirms that such a culture is not currently created in construction companies working in the Saudi Arabian oil and gas sector which explains the high rate of accidents within the sector.

There is also the need for the policy to set key targets and benchmarks within which they operate.

7.4.3 Planning for Health and Safety for Construction in the Oil and Gas Industry

A policy on its own is not enough if it cannot be translated into practices that will have a meaningful impact. The results from this study show that the majority of the participants were not involved, to a large extent, during the planning and development of the health and safety policies within their companies and this appears to be the main reason for the low awareness within the industry. Safety culture, therefore, becomes an important requirement in terms of planning for health and safety in relation to construction in the oil and gas industry.

Mohammed (2003) suggests that a viable way to implement health and safety within the construction sector is the use of a balanced scorecard approach as it has the potential to provide a strategy to translate the organisation's safety policy into a clear set of goals across four perspectives: management, operational, customer, and learning. Planning for health and safety management should therefore consider both managerial and operational level measures. Fang and Wu (2013) indicate that the complexity and evolutionary process of safety culture in a construction project team is different from that of other organisations. Adding the oil and gas industry to this already complex condition makes

planning for health and safety within the construction industry more complex, thereby requiring attention from all levels within the company.

Planning should identify and determine key measures to ensure health and safety including the identification of relevant management standards to be used by the companies. According to Manu et al., (2010), construction projects feature the nature of the project, method of construction, site restriction, project duration, procurement systems, design complexity and level of construction and subcontracting. These must be taken into consideration during the planning or implementing of health and safety management within the construction industry. From their perspective, these factors cover organisational, operational and physical attributes of construction.

Data from this study suggests that most workers within the industry don't believe these companies have t been able to clearly influence health and safety policies through the measures developed.

7.4.4 Training of Employees on Health and Safety Risks and Site Safety Management Plans

This presents a very important aspect of the framework as it focuses on the individual workers who are at the forefront of the activities involved in the process. Safety training has been recognised for years as a key part of ensuring that health and safety in any organisation is achieved. Fang and Wu (2013), confirmed that safety training was one of the eight factors identified by Zohar (1980) in his "Safety climate in industrial organisations: Theoretical and applied implications." From this perspective, safety education and training could help to improve the awareness and competence of employees

and related parties to work safely and to cultivate a positive safety culture in the organisation or project (Fang and Wu, 2013).

The data analysis in this study shows that there is some form of training for safety within organisations but in most cases, this is inadequate. The framework for health and safety management within the organisations therefore considers health and safety education and training as a key requirement to ensure the policies and management measures designed are embedded into all levels of the organisation.

7.4.5 Implementing Health and Safety Measures

Implementing health and safety measures within the construction industry working in the oil and gas sector is a key requirement to ensure health and safety issues on projects are properly managed. Teo and Feng (2011) reported that project specific features, such as project duration, project size, and contractor registration grade, are found to influence the relationship between safety climate and safety culture. Implement health and safety management for oil and gas construction projects, specific project features presented by the nature of such projects must be taken into account. Kennedy and Kirwan (1998), explain safety management as the documented and formalised of safety management systems in terms of (policy, procedures, training, instructions and resources and controlling against risk or harm Chouldry and Fang, 2007). This requires a systematic approach to safety management. To achieve this, there is the need for clear lines of communication regarding safety issues and actions. Thompson et al. (1998) stated that line managers played a huge part in clearly communicating safety measures to their teams.

Hale (2000) identified a number of elements associated with health and safety management and culture, as

- acknowledging the importance of safety,
- involvement of workers at all levels,
- creating the role of safety staff,
- ensuring the caring trust (that all parties keep a watchful eye and helping hand to cope with inevitable slips and blunders),
- openness to communication,
- belief in safety improvements,
- Integration of safety into the organisation.

Implementing safety measures therefore becomes a company-wide requirement which can be adopted for all the company's projects. Thus, as part of implementing health and safety management for construction projects within the oil and gas sector, there should be a realistic management system for health and safety.

Teo and Feng (2011) reported that the safety climate has an impact on the three dimensions of safety culture, which are psychological, situational/environmental and behavioural aspects. Implementing a health and safety management system therefore should also ensure that these aspects of safety within the company are all taken into consideration. Manu et al, (2010) suggest that understanding the extent to which construction project features influence health and safety issues is a prerequisite for implementing proper measures to ensure safety.

7.4.6 Monitoring, Measuring: Audit and Review of Performance

A key aspect of management is the need to monitor performance, which helps to measure progress against targets. As part of the framework for health and safety management for construction within the oil and gas sector, there is a need to ensure that a system to

measure health and safety performance is put in place. Molenaar et al. (2009) suggest that measuring performance in terms of health and safety should consider five key areas: "(1) a company's safety commitment; (2) safety incentives that are offered for safe performance; (3) subcontractor involvement in the company culture; (4) field safety accountability and dedication; and (5) disincentives for unsafe behaviours. The idea to monitor and measure performance of the company or project in terms of health and safety enables knowledge to be captured from the successes and failures of the project which can be ensure that transfer to other projects managed by the company.

The framework developed in this study to manage health and safety is shown in the Figure7.1

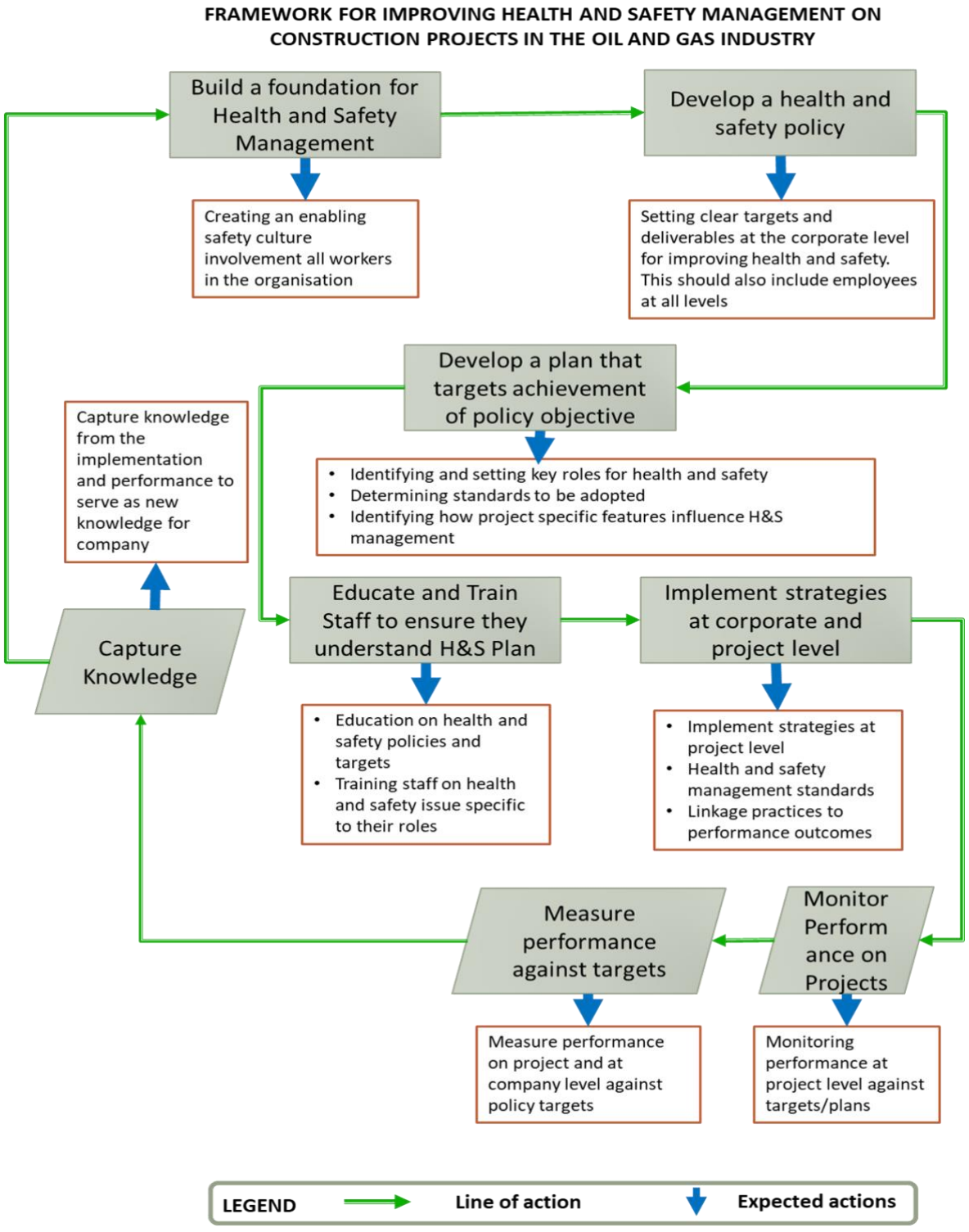

Figure 7.1: Best Practice Framework for Health and Safety Management in the Oil and Gas Construction Project

7.5 Implementation of the Framework

The framework for health and safety management presented in this section is focused on construction companies working in the oil and gas sectors. It will serve as a guide to implement health and safety related issues during their business operations.

7.5.1 Foundation Development

Figure 7 shows the first steps in the implementation process which highlight the need to develop a foundation for proper health and safety management within the company. This ensures that a culture and environment which supports health and safety are created in the company. This should encompass everyone in the company from management down to all employees. A clear understanding of the implications of working in the oil and gas sector is the first step to building a foundation for health and safety management. There should be a clear willingness from the company management to promote health and safety as a key organisational goal. For construction companies working in the oil and gas sector in Saudi Arabia, this means there should be a clear leadership direction for health and safety, beginning with a cultural change in the company by making it a key part of the organisational culture. This means safety should become a language within the company and on all projects undertaken by the company by helping all workers to see the need for safety and understand that it is as important as all other project goals.

7.5.2 Developing a Policy for Managing Safety

There is a need to create a culture that supports safety which is policy driven and easy to implement. Safety policy should clearly indicate the target of the company in terms of accident prevention and should be developed in consultation with all the staff of the company including project level or site level staff who can provide input based on their

experience from being on site. This policy should then become one of the benchmarks for safety within the company. Safety personnel will take responsibility for implementing the policy by ensuring that all hierarchical levels within the company are made aware of and are in support of the policy.

7.5.3 Planning to Implement Health and Safety Measures during Construction Projects

To ensure success of the health and safety policy, measures should be put into place to translate the policy into action. There should, therefore, be managerial roles dedicated to ensuring compliance and enforcement at all operational levels. The adoption of health and safety standards, therefore, should become part of the planning process as the standards can clearly show the direction and actions to be taken by the company. Planning for health and safety within the construction company should take into consideration project-specific features, as this will enable the company to decide on the aspects of the project to be included in the planning process.

Planning for health and safety should identify roles and actions to be taken to prevent accidents, including the use of personal protective equipment. This should also depend on the nature of the project at hand.

7.5.4 Training of Staff on Health and Safety Measures

Employee training and education form a key part of ensuring that health and safety measures are properly implemented on construction projects within the oil and gas industry. Once plans have been made to translate policies into practice, there should be a conscious effort to ensure that all parties involved in the project and the relevant people within the company have the required level of knowledge. Training will contribute

towards ensuring a safety culture is created in the company, thus leading to increased awareness and competence in the workforce. There is a need to ensure that all workers in the company and on projects are made aware of the dangers associated with their work sections and that the necessary support is put in place to ensure safety practices are followed. Training of the workforce should also ensure that safety manuals and bulletins are provided and updated on a periodic basis, based on new information developed by the safety team in the company. Training should be carried out by health and safety officers (personnel) who understand the demands of health and for oil and gas construction projects. To ensure training achieves the required outcomes, investments should be made in subscribing to health and safety manuals and training materials which will cover the most up to date health and safety issues in the industry. Options for training can include tool box talks, periodic (weekly or monthly) workshops on projects for on-site teams as well as role playing scenarios which gives the site teams various safety issues to deal with. The construction companies should also ensure safety manuals are prepared based on the nature of construction activities undertaken by the company. Health and safety officers should be present on construction sites to record safety incidents and issues as well as ensure site teams adhere to safety measures and standards. This will serve as a resource to train site teams on specific issues they are likely to encounter on projects. Materials for training purposes should be updated with knowledge captured from the performance of projects the company has undertaken.

7.5.5 Implementing Safety Measures

Following the training of the workforce on safety policy, there is a need to ensure that all the safety measures are appropriately implemented on projects. As part of implementing safety measures, there should be a company level safety strategy that clearly identifies the means for meeting the requirements of the safety policy in the company. There is a need to set up a health and safety management department within the company that concentrates on corporate level safety issues. Implementation at the corporate level will then provide the platform to decide and apply project level practices and actions.

Implementing safety measures should part of the process to ensure that project attributes are taken into consideration. For project level implementation of safety practices, the training provided at this level should indicate best practice actions to be undertaken by the workers on the projects.

7.5.6 Monitor and Measure Performance of Health and Safety on Projects

To ensure the company meets its targets in terms of health and safety, performance needs to be monitored at the project level as well as at the corporate level. Measuring progress at the corporate level should target the extent to which the company is meeting the targets set in the health and safety policy of the company. Performance measurement demands a periodic measurement of the performance on projects against the targets set for the project. For this reason, there should always be a target set for all projects undertaken by the company.

As part of the implementation of safety measures, it is necessary to record the practices during the project and outcomes in terms of health and safety issues and performance.

This then forms the basis to compare project performance against targets. At the end of every project, there should, therefore, be a performance review undertaken by the management of the project.

7.5.7 Knowledge Capture and Review of Plans

The last portion of the implementation process focuses on the capture of knowledge learnt from the project in terms of health and safety management and using this knowledge to improve practices in the company. This requires development of a knowledge management system at the project and company level. The capture of knowledge can serve as a means to identify new areas in terms of health and safety management which can then influence policy decisions and training of staff on health and safety measures in the future.

7.6 Summary of Chapter Seven

This chapter has discussed the need for a best practice framework to improve the health and safety performance on construction projects within the oil and gas sector in Saudi Arabia. As captured from the data collection and analysis, performance is poor in terms of health and safety due to the current approach of managing health and safety which in most cases, is not inclusive of the workers within the companies. The framework developed therefore considers the best practice approach that can be taken to ensure health and safety is pursued on all projects.

According to the framework, a best practice approach to health and safety should be designed for the organisational level and not just the project level. This will improve organisational health and safety management culture and climate and promote safe working standards on all projects. This chapter presents the framework for improved

health and safety management at the project level by developing a foundation for health and safety in construction companies. The development of the foundation considers a change in culture followed by the development of health and safety policies with clear targets on what is to be achieved in terms of health and safety on construction projects. The framework developed also considers the need to train construction personnel on safe working practices related to their construction activities. The best practice framework suggests that performance measurement should be a key part of the process as this can help to identify areas of poor performance. Identifying such areas, in turn, helps to formulate measures to improve them.

The implementation guide produced for the framework ensures that construction companies are able to adopt and follow the requirements of the framework in order to achieve the best results in health and safety management.

CHAPTER EIGHT: RESEARCH VALIDATION AND FRAMEWORK EVALUATION

8.1 Introduction to Chapter Eight

As presented in the previous chapter, the best practice framework to manage health and safety on oil and gas construction projects in Saudi Arabia was produced from the outcome of this research. If adopted, by practitioners it is expected to make a difference in terms of the current performance of the sector and also improve the state of health and safety on oil and gas construction projects. To ensure that the framework achieves its aim, it is very important to validate the framework in terms of suitability to guide the use of health and safety policies. Consequently, this chapter presents the procedure applied to validate the framework using a scientific approach. The chapter explores the various types of validation methods employed in the literature and then adopts the one suitable for this study.

The chapter then goes on to present the approach undertaken to validate the framework, the research instrument adopted and the participants used. The outcome of the results of the validation process helps to fine-tune and draw conclusions and recommendations from this research.

8.2 Research Validation

There are various notions as to what validity of research entails. However, in social and behavioural science research where surveys are mostly used, validity deals with the extent to which the survey instruments or procedures properly measure the elements that need to be measured (Dudovskiy, 2018). In essence, research validation refers to how well a

research instrument measures what it is intended to measure. However, Brewer (2000) and Bashir (2013), established that research validation goes beyond whether a research instrument measures what is intended to be measured but also it deals with the validity of the entire research design. According to Kerlinger and Lee (2000), the process of validating research is very important because most times, research involves the invention of indirect methods of measuring attributes that have no obvious empirical background, and this raises lots of concerns as to whether such methods of measurements or research processes are indeed what the research set-out to achieve (Kerlinger and Lee, 2000). This declaration is what makes the issue of research validation very important. There are various forms of research validation processes identified in literature. The most common ones are; validity of research constructs, validity of statistical findings, face validity, content validation, internal validation and external validation.

The validity of research constructs and face and content validation have already been addressed in the questionnaire development (i.e. using pilot studies).However, the validation of statistical findings has been taken care of in the statistical analysis presented in the results and discussion section. In this chapter, the focus of validation is on the internal and external validation. According to Pelissier (2008, p. 12), *"internal validity refers to how the research findings match reality, while external validity refers to the extent to which the research findings can be replicated to other environments".* Moreover, a detailed description of these two groups of research validity is subsequently discussed.

8.2.1 External Validation

An external validation procedure ensures confidence in the research findings (Brinberg and McGrath, 1985) and the robustness of the research deals with the wider issue of

generalising the research findings (Shadish *et al.,* 2002; Fellows and Liu, 2008). Moreover, Brinberg and McGrath (1985) claimed that the external validation process enables the transformation of research findings into knowledge. There are three processes of undertaken external research validation which are; replication, boundary search and convergence analysis

8.2.1.1 Replication

As the name implies, replication is a validation process that involves repeating a research process using the same research strategy, design, and even research instruments with the view to ascertain whether the exact set of results obtained can be produced again (Rosenthal and Rosnow, 1991). In other words, its procedures are based on the question as to what extent would the same findings occur if the study is repeated with no factors varied. There are logistical constraints and financial issues that make researchers depose this sort of validation process. The reason being that the replication of an entire research study, with no alterations, is not possible given that no two occasions are ever the same (Brinberg and McGrath, 1985; Rosenthal and Rosnow, 1991). Likewise, there is huge financial implication in repeating an entire research study.

8.2.1.2 Boundary Search

This is also referred to as differentiation of discriminant validity. Boundary search validation helps to identify the boundaries or limits associated with the findings from research (Brinberg and McGrath, 1985; Rosenthal and Rosnow, 1991). This form of research validation is rarely adopted due to the consensual agreement by researchers that it was not practical to go beyond replication and convergence analysis and deliberately

search for the boundaries of research findings. In line with the aforementioned statement and due to the time and cost associated with completing a PhD programme, the researcher desists from the implementation of this validation process. However, convergence analysis was employed for this research based on some key reasons explained below.

8.2.1.3 Convergence Analysis

Convergence analysis, also referred to as triangulation, helps to assess the robustness of the research. It involves the use of several strategies or research methods to determine the agreement of research findings (Ankrah, 2007, Denzin, 2009; Bashir, 2013). However, convergence is only achieved when the agreement is substantively derived from the use of various and independent methods, models and even occasions (Brinberg and McGrath, 1985). Similar to replication, convergence validation is also repeated and the results are assessed to confirm whether they converge with the original results. However, in contrast to replication, some of the factors pertaining to the research design, strategies, and instruments are consciously varied. In this research, there are elements of convergence achieved by using multiple sources of data collection through interviews and questionnaire survey.

According to Silverman (2006), convergence validation could be achieved using a process known as respondent's validation. This process involves using the opinions of research participants to determine the validity of research findings (Creswell, 2009). This approach to convergence analysis has been used and commended by several construction management researchers (Hari *et al*., 2005; Ankrah 2007; Anvuur, 2008; Tuuli 2009; Manu 2012), and is therefore listed among published best practices and as good characteristics of research (Reason and Rowan, 1981). In this study, a follow-up interview was carried-out as the means to validate the research findings. The interviewees were

professionals with considerable knowledge on health and safety issues and therefore, their opinions could be used to authenticate the validity of research findings and the significance of the developed model for health and safety management in the Saudi Arabian oil and gas construction industry (Phua, 2004;Bashir, 2013).

A formal invitation to partake in the validation process was sent to six professionals working in upper level management, in oil and gas companies, operating in the Kingdom of Saudi Arabia. The invitation was sent along with the interview questions and the framework developed to ameliorate health and safety management in the Saudi oil and gas construction industry. Those that agreed to participate in the validation process where contacted to schedule an appointment for a face-to-face interview.

8.2.2 Internal Validation

According to Garson (2011), internal validation is undertaken to ensure that a research finding is free from bias. It is thus defined as the extent to which the validity of statements made by X is consistent or relevant with those of Y. The primary concern of internal validation is to strike out conceivable contradicting hypotheses. This form of validation could be achieved through agreement with research findings, publications and also academic validation. Manu (2012) confirmed that the aforementioned validation process has been greatly applied in construction management PhD research to check the reliability of the research findings against published works and equally subject the studies to expert judgment. Proverbs (1998), Xiao (2002), Ankrah (2007) and Bashir (2013) all successfully applied this approach to validation. Therefore, this study also adopted the same approach to establish validity by means of weighing the findings obtained from both quantitative and qualitative method against other published studies.

According to Black (1993); Bashir (2013) and De Vaus (2002), an Agreement of research findings with published work is a significant criterion for validity. This is because it shows how related a new concept or measure is to the existing concepts or measures. Thus, the agreement of findings in this study with other published studies is illustrated in chapters 5 and 6.

On the other hand, the academic validation in this study has to do with the dissemination of the findings through doctoral workshops, conferences, journal papers, and seminar paper which are subjected to peer review or independent judges. The peer review focus was particularly useful for this research as it gave the opportunity for independent judges to question the methodologies, interpretations and findings from the research (Xiao, 2002). Similarly, scrutiny, comments and feedback obtained from academic forums such as workshops, conferences, seminars and the like, were incorporated into the research which in turn improved the validity. Below is a list of publications, seminar presentations and posters used in disseminating and validating the research findings.

Publications

Alamri, R. (2016) Improving Health and Safety Management in the Saudi Arabian Oil and Gas Construction Project. *International Journal of Social Science and Human Behavior Study* [online]. **3**(1), pp. 25-26 [Accessed 12 Mar, 2017]. Available at:< https://www.seekdl.org/assets/pdf/20160523_111812.pdf>

Alamri, R. (2014) Improving Health and Safety Management in the Saudi Arabian Oil and Gas Construction Project. In the third International conference organised by the institute of research engineers and doctors, 10-11 December, Rome, Italy.

8.3 Framework Validation (Evaluation)

As stated earlier, the framework developed for the Saudi Arabian construction industry should be able to meet the intended goals and this can only happen if the framework is applicable in the given conditions. The rationale for the evaluation of the framework was to establish three main things:

a. The first rationale for the validation and evaluation process was to assess the completeness of the framework to achieve improved health and safety in the oil and gas construction projects in Saudi Arabia
b. The second rationale for the evaluation of the framework was to test the clarity of the framework and the likelihood of improving the industry by adopting the framework;
c. The third rationale for the evaluation of the framework was to test the feasibility of the applying proposed recommendations to the improved health and safety performance of oil and gas construction projects.

8.3.1 Evaluation Process to Help Validation of the Research and the Framework

Face to face interviews were conducted with professionals from the construction industry in Saudi Arabia who work on oil and gas construction projects. The choice of participants was purposely done to ensure participants had the required experience and understanding of the issues the framework was intended to solve. Out of the six participants, two were associated with the qualitative data collection during the initial stage of this research. This was an attempt to check with these people if the views expressed in the research had been correctly articulated in the analysis and discussions.

8.3.2 Background of Participants Iinvolved in the Validation and Evaluation of Framework

For the purposes of validation and evaluation, face to face interviews were conducted. These were conducted with six professionals who agreed to partake in the validity process: these included an Environmental Health and Safety manager (R1), a Health and Safety Supervisor (R2), an Executive Manager (R3), a Maintenance and Monitoring inspector (R4), a Maintenance Manager (R5), and an Assistant general manager (R6). The respondents' average working experience was six years. This means that they were knowledgeable people and therefore capable of providing significant contributions and observations regarding the outcome of the research particularly the newly developed framework, at improving health and safety management in the Saudi Arabian oil and gas construction industry.

Table 8.1 Background of participants in the validation process

Participant	***Role in Company***	***Years of Experience***	***Involvement in health and safetymanagement***
R1	Environmental Health and Safety Manager	9	Yes
R2	Health and Safety Supervisor	5	Yes
R3	Executive Manager	7	Yes
R4	Maintenance and Monitoring Inspector	5	Yes
R5	Maintenance Manager	8	Yes
R6	Assistant General Manager	5	Yes

8.3.3 Development of Research Validation Instrument

To validate the outcome of the research, an interview guide was designed with five main areas for questioning. The questions covered were:

a. How comprehensive and adaptable the framework was in achieving improved health and safety management in oil and gas construction projects
b. The relevance of the framework to the Saudi Arabian construction industry
c. The ability of the framework to serve as a guide to the Saudi Arabian construction industry
d. The extent to which the framework enlightens professionals and aids the educate of workers on health and safety issues
e. The extent to which the framework prompts the major stakeholders in the industry to take the necessary measures to improve health and safety in the construction industry

8.4 Outcome of the Validation Process

While interviewers were allowed to share their views on the framework through the validation process, they were also required to provide their opinions on the framework based on the five areas listed in the previous section. The outcome of the validity exercise was satisfactory (Table 8:2) because the respondents were in agreement with the results obtained from this study.

Table 8.2: Results from the Validity Test

Questions	1 Strongly disagree	2 Disagree	3 Average	4 Agree	5 Strongly Agree
Is the framework comprehensible and adaptable?	0	0	0	2	4
Is the framework relevant to the Saudi Arabia construction industry?	0	0	1	2	3
Can the framework serve as a guide to professionals in improving H&S?	0	0	2	0	4
Does the framework enlighten professionals on how to educate and train employees on H&S standard?	0	0	0	1	5
Does the framework prompt the industry stakeholders to embark on improving H&S practice on site?	0	1	2	0	3

On the issue of whether the proposed framework was easily comprehensible and adaptable, two of the respondents agreed that it was valid while four of the respondents' strongly agreed that it was valid. The relevance of the framework to the Saudi construction industry was generally agreed to as valid by respondents as. R1, R4, R5 and R6 particularly were pleased about the relevance of the framework commented that improving health and safety on site was good for the construction business and people's lives were going to be saved. Therefore, they explained that the framework could be easily embraced. Three of the respondents strongly agreed that the framework was valid in terms

of relevance to Saudi construction while, two of the respondents' agreed that the framework was valid. Only 1 of the respondents' agreed averagely that the framework was valid for improving health and safety standers.

Of all the participants, four respondents strongly agreed that the framework could serve as a guide to professionals in improving health and safety, and therefore agreed it was valid. Two of the respondents averagely agreed that the developed framework was valid because it could serve as a roadmap to implementing proper health and safety measures in the construction sector.

As regards to enlightening the Saudi professionals on how to educate and train health and safety professional, five of the respondents strongly agreed that the framework was valid in that respect. While one of the respondents agreed that the framework was suitable in that context.

Judging from the results of the validation of the research findings and the framework, there is an agreement that the findings and framework were valid, overall. Furthermore, the respondents were asked whether the framework was valid in prompting professionals to embark on improving health and safety on site. On this, three of the respondents strongly agreed that the framework was valid in that regards. While tow of the respondents averagely agreed that the framework was valid. However, one of the respondent disagreed with this common perception. As a feedback, some respondents' made important observations and also made recommendations on how to make the framework more valid for the study. Below are the observations by the respondents:

According to Figure 7:1, "The two arrows in the legend that is the line of action and expected action should be differentiated with colours or different type of lines." (R1)

"The framework is not appealing because of the colour combination used. I suggest you use cool colours." (R2)

"Some of the arrow heads are confusing as they show a clash of direction. Consider revising it." (R4)

"The relationships between the boxes are not properly defined." (R5)

"I suggest you include a box that will show the measure of performance against the health and safety targets." (R6).

The two arrows indicating the line of actions and expected actions were differentiated using colours and different shapes of arrows as suggested by R1. The observation made by R2 on the colour combination were amended by cautiously choosing cool colours, which made the framework more appealing. The advice given by R4 on the direction of arrows was reflected in the final framework developed in chapter 7 of this study. The suggestion made by R5 to include boxes that clearly showed relationship between other variables was properly incorporated. Finally, a box that measured performance against targets was strategically incorporated in the framework as advised by R6.

8.4.1 Suggestion for Improving the Proposed Framework

Although the framework was commended as it was, other important observations were deemed fit to be included in the framework as suggested by the respondents. The comments by the respondents are illustrated below:

"Setting clear targets and deliverables at the corporate level alone to improve H&S are not enough. Employees at lower levels must be included while developing a health and safety policy." (R1)

"It is not enough to say develop a plan that targets the achievement of a policy objective and then move on without elaborating or listing how this plan should be developed." (R2)

"I don't see where you specified that training and education on Health and Safety issues should be a continuous process." (R5)

"*The impact of poor Health and Safety measures should be clarified in the framework as a means to show the current situation of the Saudi oil and gas construction sector."* (*R6)*

8.4.2 Opinions of Respondents on the Potential Benefits Expected from the Framework

As an attempt to further validate the framework used for this study, the researcher found it equally important to elicit the opinion of respondents' on the benefits that the framework may provide for the Saudi oil and gas construction industry. Five of the respondents' comments were encouraging except for one respondent who noted otherwise. The comments are as follows:

"The framework will serve as a guide to improve Health and Safety management in the Saudi oil and gas construction sector" (R2)

"Proper implementation of the framework will help to reduce the proliferation of potential hazards on site" (R5)

"The framework advocates the education and training of staff on H&S issues which is essential for this sector that sometimes has no specifics for employment" (R4).

The results indicate that the framework has the potential to make a difference in the Saudi oil and gas industry if adopted and implemented by the stakeholders. As observed by the participants, proper implementation strategy was, however, needed if the industry would improve and benefit from the framework.

8.5 Summary of Chapter Eight

This chapter reported the procedures employed to validate the research findings in this study. Accordingly, internal and external forms of validation were employed, based on certain criteria set out in published best practices. In the external validation process,

convergence analysis was employed to solicit the opinions of research participants on the validity of the research findings. To achieve this, interviews were conducted with six professionals working in the Saudi oil and gas construction industry. These professionals acknowledged that the research findings were valid and also opined that proper implementation of the proposed health and safety management framework will help reduce the proliferation of accidents in the Saudi oil and gas construction industry. To improve the efficacy of the framework, the respondents advised to how the framework should look, and these suggestions were incorporated accordingly.

Internal validation, on the other hand, was achieved by weighing the findings obtained from both quantitative and qualitative method in this study against other published studies. The outcome showed a strong agreement with other research findings. Academic validation as part of the internal validation process, was used in this study through the dissemination of the findings via doctoral workshops, conferences, journal papers and seminar papers which were subjected to peer review or by independent judges.

CHAPTER NINE: CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE WORK

9.1 Introduction to Chapter Nine

Following data collection and analysis and finally development of the framework that will guide the health and safety management practice within the oil and gas sector in Saudi Arabia, this chapter concludes the study by measuring research outcome against set aim and objectives and then propose recommendations for practice and further research. As described in chapter one of this thesis, health and safety management in the construction industry of Saudi Arabia needed to be reviewed due to high accident rates and the resultant negative impacts on performance of companies in the industry. The risky and accident prone nature of the construction industry notwithstanding, the oil and gas sector brings with it added and more complicated risks that needed to be managed. Such projects can be said to have higher levels of risks that demand a proactive approach in order for the levels of safety to be improved. In line with this requirement for a better approach to managing health and safety issues on such construction projects, this research has developed a framework to support health and safety managers to improve business performance.

This concluding chapter is divided into five main sections. The first summarises the extent to which the aim and objectives of this research have been achieved, by measuring the outcomes of the study against the objectives set out in chapter one of the research. The next section discusses the main conclusions drawn from the research. The third considers the main contributions to knowledge made by this research and its implications. The

fourth section discusses the recommendations for industry to improve health and safety performance using the framework produced in this research. The final section puts forward recommendations for further studies.

9.2 Summary of the Achievements of the Research Aim and Objectives

From chapter one section 1.6 of this research, the study set out the aim of his research is to critically investigate the health and safety related policies and practices in construction projects within the Saudi Arabian oil and gas sector ascertain and the adequacy of existing health and safety programmes to improve health and safety management in Saudi Arabian oil and gas construction projects. To achieve this aim, six main objectives were pursued. The extent to which the objectives were met, which ultimately determined the extent to which the aim was met, is provided in table 9.1 below.

Table 9.1 : Summary of achievements of the research objectives

Research Objective	Achievement of objectives	Evidence in this thesis
To explore the in-depth existing research on health and safety management in the construction industry, so as to develop a theoretical understanding of the current situation of health and safety management.	To put the research into context, it was necessary to explore an in-depth the issue of health and safety within the construction industry. This helped to get a better perspective of the problem and the current approach taken to ensure such problems are properly managed or controlled. A conceptual framework was developed in this regard.	Evidence for the achievement of this objective is provided in chapter 2 of this thesis. The conceptual framework is found in Chapter 3, section 3.3.1
To critically review the existing literature on health and safety management in the Middle East construction industry, so as to bring together several factors influencing safety programs that have been identified in previous studies,	This objective was achieved by a critical review of literature on the state of the art regarding health and safety management in the Middle East construction industry and the current approach taken to explore and manage the problems. This review also considered the current state of construction and the prevalence of safety issues in the industry.	Evidence for this is shown in chapter 1, chapter 2 and chapter 3.
To investigate and document the factors influencing safety programmes that are peculiar to oil and gas construction projects in Saudi Arabia.	Investigating factors that influence health and safety measures and programmes the problems in the oil and gas industry construction projects helped to identify the key elements that should be given attention during the process of managing health and safety.	Evidence for this is found in chapters 5 and 6 of this research.

To integrate factors influencing safety programmes and to critically assess their impact on Saudi Arabian oil and gas construction sites.	Investigating factors influencing safety programmes on construction sites and their impact on Saudi Arabian oil and gas construction sites took the form of both qualitative and quantitative data collection and analysis from the relevant personnel involved in the process.	Evidence for this is found in chapters 5 and 6 of this research.
To develop a framework that can help construction health and safety managers to focus their priorities on factors that will significantly reduce accidents at construction sites.	Developing a framework to ensure that construction health and safety managers focus on the relevant areas which serves to provide a good basis for improved health and safety in the industry. The framework developed from this research considers both corporate level and project level policies that can be put in place in this regard. The framework has also developed an implementation guide that clearly identifies the actions to be taken by all parties forming part of the process to enable a concerted approach towards improving health and safety on construction projects in the oil and gas sector in Saudi Arabia.	Evidence for the development of the framework including the implementation guide is found in chapter 7. See 7.4 for the framework and 7.5 for the implementation guide.
To test and demonstrate the applicability of the developed framework.	To ensure the framework produced from the outcomes of this research helps in contributing to improvements in the health and safety management of construction projects within the oil and gas sector, the completed framework was presented to professionals within the construction industry involved in projects within the oil and gas industry in Saudi Arabia. Through a validation process, the professionals were asked to evaluate the applicability and usefulness of the framework. This helped to update and amend the framework based on views shared by these professionals.	Evidence of the validation of the framework and suggestions for improvement are found in chapter 8, section 8.4

9.3 Main Conclusions from the Research

The conclusions from this research in terms of the objectives and research questions posed are discussed in this section. Considering the perspectives on health and safety management and the performance of construction companies in the oil and gas industry in Saudi Arabia and development of a suitable framework to guide good practice, the research makes the following conclusions.

9.3.1 Performance of Construction Companies in Relation to Health and Safety

In terms of the performance of the construction companies in relation to health and safety, this research concludes that current performance levels within the industry are low. The basis for the conclusion is that the low level of performance is related to different issues including but not limited to: a low level of health and safety education in the industry; poor planning for health and safety at the company levels within the construction industry; poor attitudes towards health and safety by construction workers involved in projects and poor implementation of health and safety policies where companies have such measures in place.

In this regard, the research also concludes that there is little involvement of project level staff in the formulation of health and safety measures and this is to a large extent responsible for the low level of safety.

9.3.2 Levels of Awareness of Risks and Health and Standards

This research concludes that there is a very low level of awareness of construction personnel of health and safety risks involved in their activities. This low level of awareness contributes to the high level of accidents in the industry. From the results of

the study, this research concludes that the low level of awareness of construction personnel on the levels of risks pertaining to their work is evident in all the different sizes of companies. The low level of awareness is however higher in small and medium-sized companies than it is in the large companies.

In terms of awareness between the different levels within the companies, this research concludes that there is generally a low awareness across all the levels of workers within the company. There are, however, better levels of awareness of health and safety risks for personnel in high level management compared to low level staff.

In terms of measures adopted in the companies to manage health and safety issues on construction projects, this research concludes that the very low level of awareness is evident across all levels within the companies and across the different sizes of companies. This low level of awareness is linked to the situation where construction workers are excluded during the design and development of health and safety policies and measures.

9.3.3 Health and Safety Management of Construction Projects within the Oil and Gas Industry

This research concludes that the nature of the oil and gas industry, coupled with the risky nature of construction activities, presents a higher risk which leads to increased health and safety issues when constructing in the sector. From the results of this research, it can be concluded that construction projects in the oil and gas sector are riskier and therefore demand approaches and strategies specific to the type of projects undertaken.

The Saudi Arabian construction industry and the oil and gas industry in general can be said to be performing poorly due to the lack of a holistic approach towards the subject of protection of lives as a result of exposure to hazards within the industry. This research

concludes that an improved safety culture therefore, will be the way forward to enhance overall performance business in the industry.

9.3.4 The Way Forward for Improved Health and Safety Management on Construction Projects within the Oil and Gas Sector of Saudi Arabia

This research concludes that the way forward to improve health and safety management practice during construction projects in the oil and gas industry of Saudi Arabia is the need to have a holistic approach towards health and safety and incorporating it as a key part of the company culture. This requires the company to invest in health and safety infrastructure and development of effective policies within the company. The research concludes that a better climate for safety will have a better influence on the company and ultimately on all the company projects. To improve the health and safety performance of the construction projects, it is necessary to clearly lay out strategies which targets the project specific features in the oil and gas industry.

The framework developed through this research, therefore, serves as a guide and the way forward for oil and gas industry construction projects.

9.4 Main Contributions of the Research

From the outcome of this research, a number of contributions are made towards improving health and safety management for construction projects in general and specifically for construction projects in the oil and gas industry. The contributions of this research can be seen in terms of contributions to theory on health and safety management and contributions to practice.

9.4.1 Contributions to Theory

This research contributes to the current theory on health and safety management within the Saudi Arabian construction industry, by providing current evidence. The research results contribute to health and safety management for such projects in the oil and gas industry by considering how the characteristics of the industry influence and increase the health risks for such projects. The results from this research shed more light on practices within the Saudi Arabian construction industry and the need for improved practices to develop health and safety management policies and creating a safety culture. The framework developed by this research also provides a basis for further research into better approaches to improve the current level of performance.

9.4.2 Contributions to Practice

For firms within the Saudi Arabian construction industry working on construction projects for the oil and gas industry, this research contributes to improving health and safety within such companies by developing a best practice framework. The framework takes into consideration best practices from other industries and develops an approach directed at the specific nature of the construction industry and the oil and gas sector. This contribution is expected to help industry practitioners and leaders to create a safety culture within the construction industry and ultimately translate them into project level practices and policies.

The framework developed also contributes to the industry by suggesting the need for performance measurement in terms of health and safety. The framework will also enable for subsequent projects.

9.5 Recommendations for Practice

For construction companies working in the oil and gas sector, this research presents a good resource to enhance of business the performance by minimising health and safety related accidents at construction sites. The framework developed from this research is recommended as a best practice guide that can be adopted by construction companies to minimise hazards and exposure to risks at oil and gas construction sites. The implementation guide serves as a step by step guide to help industry players and leaders to ensure that they have taken all the necessary precautions to minimise exposure to hazards and accidents at construction project sites.

9.6 Limitations of the Research

Throughout the research process, from the initial idea to the collection of data, analysis, interpretation and development of the framework, every effort was made to ensure the correct procedures and processes were followed to lead the best possible outcomes. Although every effort was made to ensure that the research undertaken was free from bias and captured the most relevant issues relating to health and safety management within construction projects in oil and gas industry, a number of limitations are likely to have affected the representativeness of the issues surrounding the industry and the applicability of the framework produced. The main limitations relate to data collection as follows.

Throughout the quantitative data collection process, efforts were made to capture views from stakeholders throughout the Saudi Arabian construction industry. The key limitation here is that the research limited respondents to companies which were involved in or have been involved in oil and gas construction projects. This means that other players in the industry who had not participated in oil and gas construction projects but had the required

experience were missed from the data collection process. It was based on this that about fifteen companies could have been surveyed. Another major limitation in this research comes from the qualitative data collection phase. Although data collection for this research focused on both qualitative and quantitative data sources, it can be said that the spread of interviewees for the qualitative data presented a limitation to the research. To ensure a wider coverage of the issues in the sector, data collection would have needed to include more participants from all over the country, in order to ensure that the views presented represented the industry in its entirety.

Another limitation of this research was the lack of data collection from government agencies and personnel who were legally required to control health and safety issues. Including such people in the data collection would have helped to increase the coverage and improved the results of the data. As shown in the development of the final framework, there is a big part to be played by all stake holders including government and government agencies who ideally are the policy makers. This means that their views were very much needed in the data collection process or at least in the validation and evaluation of the framework to ensure they fully understood the requirements of the framework and its applicability so that they could give it the needed support.

The last limitation of the research comes from the framework evaluation which included a rather small number of participants considering the number of construction companies in the industry in Saudi Arabia. An increased number of participants could perhaps have resulted in increased points of view suggestions to improve the framework. In the light of the above, therefore, the framework developed represented a proof of concept which can be improve upon with additional data.

These limitations notwithstanding, the outcomes of this research can be said to represent the industry as far as possible in making the results applicable. The results from the evaluation also indicated that the framework had the potential to make a difference in the industry.

9.7 Recommendations for Further Research

Considering the outcome from this research, it is evident that health and safety within the Saudi Arabian construction and oil and gas industries posed a serious problem that needed to be solved if the current rates of accidents were to be reduced and properly managed. It is hoped that this research served as a step in the right direction as it laid the foundation to acknowledge the unique nature of construction projects within the oil and gas industry and the need to manage the specific issues of health and safety risks that occurred in this regard.

Considering the limitations of this research in terms of the number of participants taking part in the interviews and the quantitative data collection, there was a need for further research that would encompass more people within the sector and cover the majority of the areas within the country. The following areas could be pursued:

- Further research that considered implementation of the framework developed from this research in the wider national context within oil and gas construction projects. These companies will help to ensure that the framework was suitable able to achieve its intended outcomes. This extended study would have the potential to ensure that aspects of the framework that needed to be revised were correctly identified and revised accordingly.
- There should also be further research into alternative models and a national level legislative framework for health and safety for construction projects in the oil and

gas sector. This framework can consider the legal basis for developing and enforcing relevant legislation that can help tackle health and safety problems within the industry.

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APPENDIX 1: Invitation to participate in the interview

Faculty of Science and Engineering

University of Wolverhampton

MI Building

City Campus Norh

Wulfruna Street

Wolverhampton WV1 1ly

United Kingdome

4 December 2016.

INVITATION TO PARTICIPATE IN THE INTERVIEW

Dear Sir,

I am a research student at the University of Wolverhampton undertaking a Ph.D. research on a development model for health and safety management in Saudi Arabia in oil and gas construction sector. I would like to invite you to participate in an interview, as part of the research, which aims to investigate existing models used for the safety and health management in Saudi Arabia's gas and oil construction project along with improved model for effective health and safety practices.

However, the information that is provided by the participants will be kept confidential and will only be used for academic purposes.

If you have any questions or queries, please do not hesitate to contact me. I will be very thankful and appreciate your contribution and cooperation in this research study.

Yours sincerely,

Reem Alamri
Doctoral Research Student
Faculty of Science and Engineering
University of Wolverhampton Mob: [redacted] Email: [redacted]

APPENDIX 2A: Interview for upper level management

Section A: Personal Information

1. What is the designation you hold in your organisation?
2. How long have you been working in the oil and gas company?
3. What roles do you play in the current position regarding the safety on projects?

Section B: Health and Safety Measures in Oil and Gas Construction Company

1. Why is it important for an oil and gas construction company to undertake health and safety measures for its employees?
2. What, according to you, are the measures that need to be taken under the health and safety provision?
3. What are the main reasons that led you to undertake health and safety measures?

Section C: Effectiveness of Health and Safety Measures

1. To what extent will health and safety measures help in preventing accidents occurring at the construction site?
2. In what ways have you benefited by applying health and safety measures in the oil and gas construction company?

APPENDIX 2B: Interview for Middle level management

Section 1: Personal Information

1. What is the designation you hold in the company?
2. How long have you been working in the oil and gas construction sector?
3. Do you think that there is a need to have proper integration between employees and health and safety management? If yes, please elaborate on your answer?
4. Please indicate the advantages of weekly risk management planning in the organisation?

Section B: Health and Safety Measures

1. What factors need to be considered while undertaking health and safety measures by the company?
2. According to you, to what extent are health and safety measures important and need to be implemented in the oil and gas construction company?

Section C: Opinion about Survey

1. Please mention some issues in your organisation regarding health and safety management.

APPENDIX 2C: Interview for lower level management:

Section A: Personal Information

1. How long have you been working in the oil and gas construction sector?
2. Is any action taken by management related to the prevention of your exposure to health risks at the workplace? If yes, please elaborate?
3. Please mention your responsibility at the work place?

Section B: Organisational Experience

1. What aspects of the risk assessment framework can be applied at the workplace to determine prospective risks?
2. What are the main health and safety aspects of the working environment in your organisation?
3. As per your opinion, what are the benefits of implementing health and safety management policies?

Section C: Effectiveness of Health and Safety Measures

1. Do you think that risk management techniques and the performance of employees are interrelated? Please elaborate on your answers:
2. Please elaborate on some major benefits of having proactive planning for risk management in your organisation?

APPENDIX 3: Invitation to participate in the survey

Faculty of Science and Engineering
University of Wolverhampton
MI Building
City Campus Norh
Wulfruna Street
Wolverhampton WV1 1ly
United Kingdome
4 December 2016.

INVITATION TO PARTICIPATE IN THE SURVEY

Dear Sir,

I am a research student at the University of Wolverhampton undertaking Ph.D. research on the development model for health and safety management in the Saudi Arabian oil and gas construction sector. I would like to invite you to participate in this research and kindly complete the questionnaires, which aims to investigate the existing models used for the health and safety management in Saudi Arabia's gas and oil construction projects along with improved model for effective health and safety practices. A copy of the questionnaire is attached and it is estimated to take approximately 15-20 minutes to complete. Data obtained from the questionnaire will be treated with strict confidence and used for academic purposes only. If you have any questions or queries, please do not hesitate to contact me.

I will be very thankful and appreciate your contribution and cooperation in this research study.

Yours sincerely,

Reem Alamri
Doctoral Research Student
Faculty of Science and Engineering
University of Wolverhampton
Wolverhampton
Mob: [redacted] / Email: [redacted]

APPENDIX 4: Questionnaire

Please complete the following questionnaire on health and safety in oil and gas construction projects to the best of your knowledge. There is no right and wrong answer.

SECTION A

DEMOGRAPHIC INFORMATION

1. Please indicate your age bracket
    a. Under 25 years
    b. 25 – 29 years
    c. 30 – 34 years
    d. 35 – 39 – years
    e. 40 – 44 years
    f. Over 45 years
2. How many years have you been working in the construction industry?
    a. Under 5 years
    b. 5 – 9 years
    c. 10 – 14 years
    d. 15 – 19 – years
    e. 20 years and over
3. What is your current role in your construction company?
    a. Environmental Health and Safety General Manager
    b. Project Manager
    c. Construction Manager
    d. Quantity Surveyor
    e. Site Manager
    f. Other – please specify _____
4. How many years have you been in the current role?
    a. Under 5 years
    b. 5 – 9 years
    c. 10 – 14 years
    d. 15 – 19 – years
    e. 20 years and over
5. What is the size of organisation you work with?
    a. Large construction company
    b. Medium construction company
    c. Small construction company
6. How of workers are in your organisation?
    a. Less than 50 workers
    b. 50 – 99 workers

c. 100 – 149 workers
d. 150 – 199 workers
e. 200 workers and over

7. Which of the following correctly identifies the company you work for?
    a. Main contractor
    b. Consultant
    c. Subcontractor
    d. Others – Please specify
8. Which of these oil and gas construction projects have your company been involved in? Tick as many as are applicable
    - ❖ Off shore platforms
    - ❖ Oil platforms and production lines
    - ❖ Off shore oil fields
    - ❖ Oil refineries
    - ❖ Oil and gas drilling facilities

SECTION B

HEALTH AND SAFETY MANAGEMENT

Please answer the following questions based on your knowledge of the health and safety management practices within your company.

9. To what extent are you involved in the formulation of health and safety policies in your company?

Never	Rarely	Occasionally	Very frequently	Always
1	2	3	4	5

10. To what extent does the health and safety policy in your company contribute to improving health and safety in your organisation?

Not at all influential	Slightly influential	Somewhat influential	Influential	Extremely influential
1	2	3	4	5

11. To what extent do you think the health and safety legislation in Saudi Arabia are effective in ensuring health and safety within the construction industry?

Not at all effective	Slightly effective	Fairly effective	Very effective	Extremely effective
1	2	3	4	5

12. To what extent would you say the health and safety management practices of your company are tailored to meet the demands of oil and gas construction projects?

No effective at all	Slightly effective	Fairly effective	Very effective	Extremely effective
1	2	3	4	5

13. From your experience, to what extent do you believe these measures help in achieving health and safety in oil and gas projects?

Not at all influential	Slightly influential	Somewhat influential	Influential	Highly Influential
1	2	3	4	5

14. How familiar are you with the health and safety policies available in your company?

Not at all familiar	Slightly familiar	Somewhat familiar	Moderately familiar	Extremely familiar
1	2	3	4	5

15. To what extent does your company adhere to health and safety policies in your company?

Never	Rarely	Sometimes	Often	Always
1	2	3	4	5

Benefits of ensuring health and safety management on projects

16. To what extent are the health and safety measures adopted by your company important in achieving the following?

	Benefits of health and safety management	**Level of importance**				
		Not at all important	Slightly important	Moderately Important	Important	Extremely important
		1	**2**	**3**	**4**	**5**
1	Raising the level of productivity					
2	Protection of workers or employees from any potential hazard					
3	Maintaining the company's reputation					
4	Financial losses					
5	Raising the loyalty of workers and employees to the company					
6	Preventing any delay in the workflow					
7	Protecing the environment					
8	Raising clients' satisfaction					
9	Raising employees' awareness and experience concerning work regulations and safety measures					
10	Demonstrating employees' competence and awareness					

17. To what extent do the health and safety policies in your company impact on the welfare of employees on your project?

No influence at all	Slightly influential	Somewhat influential	Influential	Extremely influential
1	2	3	4	5

Ensuring health and safety management in construction projects

18. To what extent are the following measures adopted in your company towards improving health and safety on oil and gas construction projects?

Measures for improving health and safety performance		**Extent of application**				
		Never	**Very rarely**	**Occasionally**	**Frequently**	**Always**
		1	**2**	**3**	**4**	**5**
1	Planning and monitoring H&S implementation					
2	Monitoring and improving the level of awareness concerning occupational H&S measures					
3	Periodic investigation of any hazards or malfunction in machinery and equipment (risk assessment)					
4	Commitment by employees and workers to health and safety programmes					
5	Keeping in touch with the latest updates concerning H&S programmes					
6	Proper collaboration between employees and H&S management					
7	Attending seminars relating to H&S					
8	Cooperation with governmental organisations in maintaining safety for employees and workers					
9	Provision of adequate PPE for employees					
10	Participating in determining the rules or programmes relating to H&S					

19. From the table below, please indicate the extent to which the factors provided act as barriers to the achievement of health and safety on your oil and gas construction projects.

Barriers to health and safety management		**Extent of agreement**				
		Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
		1	2	3	4	5
1	Uncertainty over the roles of parties towards safety management					
2	Lack of adequate training					
3	Poor attitude of staff towards health and safety					
4	Lack of consistent business support policy					
5	Lack of effective participation by management					
6	Lack financial resources					
7	Non definition of occupational health and safety (OHS) as one of company's strategic objectives					

8	Lack of strategic vision for health and safety					

20. How is health and safety management education conducted in your organisation? (Tick as many as applicable)

Approach to health and safety education		**Application of health and safety education**				
		Never	Seldom	Sometimes	Often	Always
		1	2	3	4	5
1	Tool Box talks					
2	Monthly bulleting					
3	Online Education					
4	Simulation and role play exercises					
5	Orientation and trainings					
6	Proprietary safety training videos and demonstrations					
7	Use of safety mentors					
8	Use of safety newsletters					
9	Safety bulletin boards					

21. To what extent are the following sources of health and safety knowledge applied in your organisation

Measures for achieving health and safety on projects		**Extent of application**				
		Never applied	Seldom applied	Sometimes applied	Often applied	Always applied
		1	2	3	4	5
1	Self-inspections					
2	Group brainstorming					
3	Accident analysis					
4	Job hazard analysis					
5	Informal discussions with project teams					
6	Health and safety standards					

22. Please identify from the list below the extent to which the following means are adopted in building a safety culture in your company.

Measures towards creating a safety environment		**Frequency of use**				
		Never	Seldom	Sometimes	Often	Always
		1	2	3	4	5
1	Safety Behaviour sampling					
2	Management and workforce support and ownership of safety issues					
3	Use of safety behavioural checklist					
4	Modifying of workforce environment					
5	Weekly safety inspection plan					
6	Monitor safety performance and review safety checklist					
7	Hold safety meetings and allocate corrective work					
8	Develop safety avoidance strategies and design feedback					

APPENDIX 5: Answered questionnaires in Arabic with a translation in English form

Interview for upper level management

Large Size Company

Section A: Personal Information

1. What is the designation you hold in your organisation?

   Environmental health and safety general manger

2. How long have you been working in the oil and gas company?

   عشر سنوات

3. What are the roles you play being in the current position regarding the safety on projects?

   المشاركه في وضع القوانين والبرامج الخاصه بالصحه والسلامه والاشراف على تطبيقها والاطلاع على اخر التحديثات العالميه حول برامج الصحه والسلامه وحضور المواتمرات الخاصه بها

Section B: Health and Safety Measures in Oil and Gas Construction Company

1. Why is it important for an oil and gas construction company to undertake health and safety measures for its employees?

   ١-للامثثال لتشريعات والانظمه وتطبيقها على ارض الواقع

   ٢-للمشاركه في سلامة البيئه

   ٣-للمحافظه على سير العمل بدون اي حوادث اومعوقات ورفع مستوى الانتاج

٤- للحرص على سلامة العمال من الحوادث واحساسهم بالامان في ساحة العمل

٥-للمحافظه على سمعة الشركه

2. What according to you are the measures that need to be taken under the health and safety provision?

التطبيق للانظمه وتشريعات الصحه والسلامه المهنيه على ارض الواقع من الاداره العليا الى الادارات السفلى والموظفين والاجتماعات الدوريه بخصوص اخر التحديثات للانظمه لبرامج الصحه والسلامه

ورسم الخطط الفعاله لتقليل من الحوادث والنظر الى اسبابها

وتنضيم الدورات التريبيه للموظفين والعمال حول برامج الصحه والسلامه

3. What are the main reasons that led you to undertake health and safety measures?

لتقليل والحد من الحواث التي قد تكون من اهم اسباب تاخير العمليلت وسير العمل والخساره في كثير من الاموال

Section C: <u>Effectiveness of Health and Safety Measures</u>

1. To what extent will the health and safety measures help in preventing the accidents occurring at the construction site?

في شركاتنا هناك برامج فعاله لصحه والسلامه المهنيه مثلا لدينا شعبة الطب المهني وهي مخصصه في الوقايه من الاصبات والامراض المعديه وادارة العجز وتعزيز الصحه والسلامه وهذه الشعبه تتالف من استشاريين الطب المهني و خبراء الصحه واخصائيين وفي فحص العمال الجدد من حيث القدرات السمعيه والنظريه وكذالك نحن نقوم بالجان التي تقيم العجز المهني للمظفين وتقييم مدى الاصابه

2. In what ways have you benefited by applying health and safety measures in the oil and gas construction company?

احساس العمال بالامن البيئي الذي يودي الى رفع الروح المعنويه وبالتي زياده الانتاجيه لديهم

وسير العمل في الاتجاه السليم

Interview with upper-level management

Large-sized company

Section A: Personal Information

1. What is the designation you hold in your organization?
   Environmental health and safety general manager.

2. How long have you been working in the oil and gas company?
   I've been working with this company for ten years.

3. What are the roles you play being in the current position regarding the safety on projects?
   - Participating in determining the rules or programs relating to health and safety.
   - Monitoring their implementation.
   - Keeping in touch with the latest updates concerning health and safety programs.
   - Attending seminars relating to health and safety.

Section B: Health and Safety Measures in Oil and Gas Construction Company

1. Why is it important for an oil and gas construction company to undertake health and safety measures for its employees?

- Submitting to the necessary regulations and rules and applying them in the workplace.
- This can help in saving the environment.
- Preventing any delays in the workflow.
- Raising the productivity.
- Maintaining the company reputation.
- Protecting workers or employees from any potential hazards.
- Raising their loyalty of workers and employees to the company.

.....

2. What according to you are the measures that need to be taken under the health and safety provision?

- Applying all rules and regulations concerning health and safety in the workplace.
- Periodic meetings.
- Determining the effective actions to reduce any potential accidents.
- Offering seminars and training courses to employees.

3. What are the main reasons that led you to undertake health and safety measures?
   The main reasons are to prevent any delays, financial losses, or time loss. We also care a lot about our employee's health and safety.

Section C: Effectiveness of Health and Safety Measures

1. To what extent will the health and safety measures help in preventing the accidents occurring at the construction site?

In our company, there are effective health and safety programs such as Division of Occupational Medicine which helps in preventing any injuries, infections, and boost the general health and safety across the organization. It’s composed of Professional medicine consultants, health experts and specialists to test employees hearing and vision periodically.

2. In what ways have you benefited by applying health and safety measures in the oil and gas construction company?

Employees feel that they are protected from any hazards and thus the productivity is boosted.

.....

Interview for Middle level management

Large Size Company

Section 1: Personal Information

1. What is the designation you hold in the company?
   Environmental health and safety inspector

2. How long have you been working in the oil and gas construction sector?
   ٧سنوات

3. Do you think that there is a need for having proper integration between employees and health and safety management? If yes, please elaborate your answer? نعم اعتقد ذالك مهم حتى لايكون هناك فجوة بين الموظفين والادارات
   فعلى رئووساء الاداراة تفهم والاستماع الى اراء الموظفين بكافة موستوياتهم وذالك يساعد

   على رفع ولاء الموظفين وتطبيق انظمة الشركة بكل قناعه وسهولة ويسر

4. Please indicate the advantages of weekly risk management planning in the organization?
   ذالك من الموكد انه يحد من الحوادث قبل وقوعها ويقلل من الحوادث واسبابها ورفع مستوى الحرص

   والحذر

Section B: <u>Health and Safety Measures</u>

1. What factors need to be considered while undertaking health and safety measures by the company?
   من ناحية العمال ننظر الى مستوى الكفاءه لهم من حيث وعيهم ببرامج الصحه والسلامه وتعاملهم

   مع الحوادث اثناء وقوعها وتوفير الملابس السلامه الوقائيه لهم

   من ناحية البرامج التخطيط لها والتنفيذ والنظر الى اخر مستجدات قضايا الصحه والسلامه المهنيه

   من ناحيه الالات الكشف والصيانه الدوريه لها من قبل المتخصصين

2. According to you, to what extent the health and safety measures are important to be implemented in the oil and gas construction company?
   مهم في الغايه للتعاون مع المنضمات الحكوميه والدوليه للمحافظه على السلامه والصحه المهنيه للعمال

   والبيئه والمافظه على الاناتجيه العالميه للنفط وسيرها في الاتجاه السليم

Section C: Opinion about Survey

1. Please mention some issues in your organizational regarding health and safety management?

لدينا موظفين ذات خبرات طويله في شركات البترول والغاز وهم من ساعدو في الارتقاء عالميا باسم هذه الشركه وكذالك برامج عالميه في الصحه والسلامه المهنيه التي حافظت على مستوى السلامه المهنيه مرتفع وهناك قليل من الاشكاليه التي توثر على سير العمل وهي الخلل في بعض من محركات الات استخراج والحفر ولكن استطعنا التغلب على هذه المشكله من خلال الطاقم المتخصص والمحترف في حل تلك الازمات بكفاءه وخبره عاليه

Interview for Middle-level management

Large Size Company

Section 1: Personal Information

1. What is the designation you hold in the company?
   Environmental health and safety inspector

   .....

2. How long have you been working in the oil and gas construction sector?

I've been working with this company for seven years.....

3. Do you think that there is a need for having a proper integration between employees and health and safety management? If yes, please elaborate your answer?

Yes, I think that is very important in order to avoid any gaps between employees and management. Managers should understand and listen to their employees and thus the employee's loyalty is increased and the company regulations are applied easily.

4. Please indicate the advantages of weekly risk management planning in the organization?

This reduces any potential incidents and boosts the level of safety

Section B: Health and Safety Measures

1. What factors need to be considered while undertaking health and safety measures by the company?

For employees:

Monitoring and improving the level of awareness concerning occupational health and safety measures. Offering protective clothing for them.

For plans or schemes:

Implementing them carefully.

Keeping in touch with any updates concerning occupational health and safety.

For machinery:

Periodic investigation of any hazards or malfunctions.

2. According to you, to what extent the health and safety measures are important to be implemented in the oil and gas construction company?

It's very important. Cooperation with governmental organizations can help in maintaining safety for employees and workers and thus increase the level of productivity.

Section C: Opinion about Survey

1. Please mention some issues in your organizational regarding health and safety management?

   We have employees with a long experience in oil companies. They helped in raising the reputation of the company worldwide. They are also committed to occupational health and safety measures. There are minor troubles which affect workflow such as malfunctions in digging machines, but we could solve this issue by hiring skilled and experienced teams to solve this problem efficiently.

Interview for lower level management:

Large Size Company

Section A: Personal Information

1. How long have you been working in the oil and gas construction sector?
٥سنوات

2. Is any action taken by the management related to the prevention of your exposure to health risks at the workplace? If yes please elaborate?

نعم وذالك من خلال توفير اللبسه الواقيه وعمل التدريات والدروات المتعلقه بالصحه والسلامه

والمراقبه والاشراف من خلال مختصين على برامج الصحه والسلامه

3. Please mention your responsibility at the work place?

صيناة الات والكشف عن حالات الخلل في المعدات

Section B: Organisational Experience

1. What aspects of risk assessment framework can be applied at the workplace to determine prospective risks?
الاشراف ومراقبة العمال من حيث التقيد بالانظمه الصحه والسلامه من حيث البسه الوقائيه

تطبيق نظام العمل في فصل الصيف

توفير الوحات او الافتات الارشاديه

المراقبه الدوريه للالات وصيانتها

التخطيط المناسب والامن بالاضواء الفسفوريه للساحة العمل

2. What are the main health and safety aspects of working environment in your organization?
الامتثال لتطبيق برامج الصحه والسلامه من قبل الموظفين والعمال

3. As per your opinion, what are the benefits of implementing health and safety management policies?
التقليل والحد من الحوادث

اثبات كفاءة ووعي الموظف

اثبات ولاء الموظف

التقليل من التكاليف على المنظمه الناتجة عن التصرف السليم للموظف تجاه المخاطر المحتمله

Section C: Effectiveness of Health and Safety Measures

1. Do you think that Risk management techniques and performance of employees are interrelated? Please elaborate on your answers:
نعم لان رسم الخطط متعلق بالاخطار المواجه للعمال وكذالك تنفيذها يكون من قبل العمال

2. Please elaborate on some major benefits of having proactive planning for risk management in your organization?
التقليل من الحوادث والتكاليف الناتجه عنها وتاخير سير العمل احساس العمال بالرضى والامن ورفع

مستوى الاحتياط

Interview for lower level management:

Large-sized company

Section A: Personal Information

. How long have you been working in the oil and gas construction sector?

I've been working with this company for five years.

.....

1. Are there any actions taken by the management related to the prevention of your exposure to health risks in the workplace? If yes please elaborate?

Yes, they provide protective clothing for us. They also offer high-skilled trainers and courses to raise awareness relating to Occupational Safety and Health.

2. Please mention your responsibility at the workplace?

I'm responsible for machines maintenance and monitoring any malfunction to solve it.

Section B: ~~Organisational Experience~~

1. What aspects of risk assessment framework can be applied at the workplace to determine prospective risks?

- Periodic monitoring of machinery and maintenance.
- Offering a proper planning and safety using phosphoric lights at the workplace.
- Applying working system in summer during hot weather.
- Offering indicative plates for necessary instructions for workers or employees.
- Supervising and monitoring workers in terms of compliance with health and safety regulations relating to protective clothing.

2. What are the main health and safety aspects of the working environment in your organization?

Commitment to health and safety programs by employees and workers.

.....

3. As per your opinion, what are the benefits of implementing health and safety management policies?

- Reducing and preventing accidents.
- Demonstrating employee competence and awareness.
- Making sure that employees are loyal to the company.
- Minimizing costs for the organization resulting from proper employee behavior towards potential risks.

.....

Section C: Effectiveness of Health and Safety Measures

1. Do you think that Risk management techniques and performance of employees are interrelated? Please elaborate on your answers:

Yes, because the plans are related to the dangers faced by the workers. Employees are also responsible for implementing them.

2. Please elaborate on some major benefits of having proactive planning for risk management in your organization?

- Reduction of the accidents and costs resulting from lack of risk proactive planning for risk management.
- Delays are also avoided.
- Customers are more satisfied.
- Raising safety level.

.....

Interview for upper level management

Medium Size Company

Section A: Personal Information

1. What is the designation you hold in your organisation?

   Assistant general manger

2. How long have you been working in the oil and gas company?

   ١٢سنه

3. What are the roles you play being in the current position regarding the safety on projects?

   عقد الاجتماعات الدوريه للتناقش حول برامج الصحه والسلامه من حيث الحواث والتعرف على اسبابها والتاكد من تطبيق البرامج التطبيق الفعال الذي يحد من الاثار السلبيه المترتبه من الحوادث وكذالك النزول الى ارض الميدان في جولات تفتشيه

Section B: Health and Safety Measures in Oil and Gas Construction Company

1. Why is it important for an oil and gas construction company to undertake health and safety measures for its employees?

   من المعروف ان قطاع البترول والغاز من اخطر القطاعات من ناحيه السلامه المهنيه حيث ان هذا القطاع تعدد فيه الانشطه الخفيفه والثقيله التي تعدد فيها الاخطار الكيماويه والجسديه والنفسبه والبيئيه فتوفير الامن الصحي والسلامي للعمال يكون دافع قوي لديهم في العمل في جو امان ورفع كفائتهم وانتاجيتهم وكذالك الاشراف عليهم وتدريبهم على مواجهت الحواث والتعامل معها بالاساليب السليمه وذالك لتخفيف الاثار السلبيه

2. What according to you are the measures that need to be taken under the health and safety provision?

التطبيق السليم لبرامج الصحه والسلامه المهنيه من الاداره العلياء الى الموظفين في ارض الميدان

والاشراف والصيناة الالات الدوريه

والتدريب الدوري للعمال وتوفير البسة الوقايه للعمال

والاجتماعت الدوريه والنقاش حول اخر توجهات الصحه والسلامه وتوفير البروشرات الحديثه حول اخر فعاليات الصحه والسلامه لرفع التوعيه لدى للعمال

3. What are the main reasons that led you to undertake health and safety measures?

الامانه والمصداقيه في العمل وذالك من حيث رسم الخطط السليمه للسلامه المهنيه وتنفيذها والتاكد من التزام الموظفين من تطبيقها بشكل السليم وذالك للفائده التي تعود عليهم من حيث السلامه المهنيه وكذالك الفوائد العادئه للشركه

Section C: Effectiveness of Health and Safety Measures

1. To what extent will the health and safety measures help in preventing the accidents occurring at the construction site?

ذالك يعتمد على وضوح برامج الصحه والسلامه المهنيه وقابلية تنفيذها على ارض الواقع ووعي الموظفين باهميتها والتزامهم بتنفيذها

2. In what ways have you benefited by applying health and safety measures in the oil and gas construction company?

الاحساس بالرضى الذاتي من خلال المصداقيه في اداء واجبات العمل وذالك ينعكس على الانتاج وعلى راس المال ورضى الموظفين والسمعه الحسنه بين الشركات المنافسه

Interview with upper-level management

Medium Size Company

Section A: Personal Information

1. What is the designation you hold in your organization?

Assistant general manager.

.....

2. How long have you been working in the oil and gas company?

I've been working with this company for 12 years.

.....

3. What are the roles you play being in the current position regarding the safety on projects?

- Holding periodic meetings to discuss the health and safety programs in terms of the incidents and in order to identify their causes.
- Making sure that the workers are protected and that the health and safety measures are followed accurately.

Section B: Health and Safety Measures in Oil and Gas Construction Company

1. Why is it important for an oil and gas construction company to undertake health and safety measures for its employees?

It's been known that Oil and gas sector is one of the most dangerous sectors concerning occupational health and safety. In this sector, there are so many activities which involve chemical, environmental, psychological or fatal hazards. Offering a safe and stable working environment is a necessity for employees in order to be able to work hard for the company. Seminars and training courses are also so important.

2. What according to you are the measures that need to be taken under the health and safety provision?
    - The proper application of health and safety programs from across the company different sectors.
    - Supervision and periodic machinery maintenance.
    - Periodic training of workers and the provision of protective clothing for workers.
    - The periodic meetings and discussions on the latest trends of health and safety precautions.
    - Providing brochures about the latest health and safety measures to raise awareness among workers.

3. What are the main reasons that led you to undertake health and safety measures?

Honesty and credibility at work.

This is done by the following measures:

- Determining the proper plans for health and safety measures and implementing them accurately.
- The employees should also be committed to all the necessary precautions in order to have a safe working environment.

Section C: Effectiveness of Health and Safety Measures

1. To what extent will the health and safety measures help in preventing the accidents occurring at the construction site?
   This depends on the clarity of the occupational health and safety program and how much it's possible to implement it in the workplace. It also depends on the employee's awareness and commitment concerning it.

   .....

2. In what ways have you benefited by applying health and safety measures in the oil and gas construction company?

   Satisfaction is achieved through credibility concerning the work duties and thus the productivity, client’s satisfaction, the company reputation, and the company

Profits are affected positively among all competing companies.

Interview for Middle level management

Medium Size Company

Section 1: Personal Information

1. What is the designation you hold in the company?
   Marketing manger

2. How long have you been working in the oil and gas construction sector?
   ٥سنوات

3. Do you think that there is a need for having proper integration between employees and health and safety management? If yes, please elaborate your answer?
   نعم حيث ان قدرات الموظفين مختلفه وفهمهم لكل جديد في مايختص ببرامج الصحه والسلامه متوفواته فلبد من التوعيه الدائمه لهم من خلال الدورات الدريبيه والاجتماعات الدوريه الخاصه بالصحه والسلامه والاستماع الى المعوقات التي تواجههم وبالتي رسم الخطط المناسبه للحدد وحل تلك المعوقات وكذالك نشر المنشورات الحديثه بخصوص الصحه والسلامه المهنيه لرفع مستوى السلامه المهنيه في مواقع العمل

4. Please indicate the advantages of weekly risk management planning in the organization?
   يعتبر عامل مهم للحد من الاخطار والتخطيط المناسب لدرجات الخط المختلفه وكيفية التعامل مع الحواداث التي قد تكون من اهم اسباب تاخر العمليات

Section B: Health and Safety Measures

1. What factors need to be considered while undertaking health and safety measures by the company?
   ينبغي ان تكون شامله وكافيه لحد من مخاطرالبيئه سواء الظروف الجويه القاسيه والمفاجئه وبيئة العمل كالتخطيط المناسب والامن في ساحة العمل من قبل المساحات والالوحات الارشاديه والتخطيط ذات الالوان الفسفوريه التي تقلل من حدوث الحوادث في ساحة العمل وكذالك توفر اللبسة الحمايه والسلامه للعمال وجودة الاالات والمعدات المستخدمه في ارض العمال
   والتاكد من مهنية وخبرة ووعي الموظفين والعمال

2. According to you, to what extent the health and safety measures are important to be implemented in the oil and gas construction company?
نحن نهتم جدا بمعايير الصحه والسلامه لدى شركتنا وموظفيننا وعمالنا لان ذالك يساعد على سير العمل

في الاتجاه السليم بعيدا عن التاخر في العمليات التي تودي الى اضرار ماليه ووقتيه

Section C: Opinion about Survey

1. Please mention some issues in your organizational regarding health and safety management?
نحن نوفر دورات تدريبيه للعمال بخصوص الامن والسلامه ويتوفر لدينا خبراء ومفتشين خارجيين

وداخليين لتاكد من تطبيق انظمة الصحه والسلامه المهنيه لكن هنا بعض الاهمال من العمال في تطبيق هذه

الانظمه لكن المراقيين في ارض العمل لهم دور كبير في تنبيه والزام العمال لتنفيذ واراسال التقرير الاوليه

لاداريين المختصين ورغم ذالك فشركتنا تعتبر من الشركات الرائه في تنفيذ ورسم برامج الصحه والسلامه

المهنيه

Interview for Middle-level management

Medium Size Company

Section 1: Personal Information

1. What is the designation you hold in the company?

Marketing manager.

.....

2. How long have you been working in the oil and gas construction sector?

I've been working with this company for five years.

3. Do you think that there is a need for having a proper integration between employees and health and safety management? If yes, please elaborate your answer?

Yes, because employees have different levels of experience. Their understanding concerning occupational and safety measures is also uneven. Seminars, periodic meetings, listening to their opinions and training courses are necessary. This helps in determining the proper plans for them. Up-to-date brochures should be provided from time to time in order to raise the level of occupational health and safety.

4. Please indicate the advantages of weekly risk management planning in the organization?

It's considered an important factor to reduce risks and offer a proper planning for all potential risks to avoid them.

Section B: Health and Safety Measures

1. What factors need to be considered while undertaking health and safety measures by the company?

They should be comprehensive and enough to avoid any environmental risks such as harsh weather conditions and working environment. A proper planning and implementation concerning occupational health and safety measures in the workplace are necessary such as offering instruction plates, phosphoric clothing or signs which help in reducing incidents. The machinery should have high quality in order to avoid any hazards. The employees should have the necessary experience and awareness.

2. According to you, to what extent the health and safety measures are important to be implemented in the oil and gas construction company?

We care a lot about occupational health and safety standards and measures in order to avoid any troubles or losses.

Section C: Opinion about Survey

1. Please mention some issues in your organizational regarding health and safety management?

We offer seminars and training courses relating to health and safety measures. We also have experts and examiners to make sure that all health and safety rules are followed accurately. Our company is considered to be a leading company in determining and implementing occupational health and safety programs.

Interview for lower level management:

Medium Size Company

Section A: Personal Information

1. How long have you been working in the oil and gas construction sector?
ثلاث سنوات

2. Is any action taken by the management related to the prevention of your exposure to health risks at the workplace? If yes please elaborate?

نعم من حيث الرقابة الميدانيه وتوفير جميع مقومات الصحه والسلامه الميدانيه ورفع مستوى التوعيه لدى العمال وتحليل مواقع الاخطار وتنفيذ الوازم لتقليصها وتنفيذخطط ادارة المخاطر

3. Please mention your responsibility at the work place?

مشغل العمليات

Section B: Organisational Experience

1. What aspects of risk assessment framework can be applied at the workplace to determine prospective risks?
مراقبة وتفحص عوامل مواقع الخطوره ووضع الخطط المناسبه لحجم الخطر وتنفيذها في حال حدوثه وتوعية العمال في ساحة العمل بلاخطار المحتمله

2. What are the main health and safety aspects of working environment in your organization?

التقليل من الحوادث في ساحة العمل والتقيد بقوانين الصحه والسلامه من قبل العمال ومراقبة وصيانة الالات

3. As per your opinion, what are the benefits of implementing health and safety management policies?
في الاول والخير المحافظه على سلامة الموظف نفسه من المخاطر المحاطه به من خلال تنفيذه قوانين الصحه والسلامه وذالك يرفع من وعيه واكتساب خبرات في هذا المجال تنفعه في شوون الحياه بشكل عام

Section C: Effectiveness of Health and Safety Measures

1. Do you think that Risk management techniques and performance of employees are interrelated? Please elaborate on your answers:

   نعم فالخطط الفعاله والتنفيذ الدقيق من قبل العمال يثبت جدارة ادارة المخاطر وتعاون الموظفين والعمال في التنفيذ وبالتالي رفع مستوى الصحه والسلامه المهنيه والتقليل من الحواداث والمخاطر

   Please elaborate on some major benefits of having proactive planning for risk management in your organization?

   التقليل من الحواث المحتمله وحالات الاصابات والوفاة والخلل في المعدات ورفع الانتاجيه وسمعة الايجابيه للشركه وتوفير الوقت والتكلفه الناتجه عن الحوادث

Interview for lower level management:

Medium Size Company

Section A: Personal Information

1. How long have you been working in the oil and gas construction sector?

I've been working with this company for three years.

.....

2. Are there any actions taken by the management related to the prevention of your exposure to health risks in the workplace? If yes please elaborate?

Yes, this includes the following points:

- Continuous field monitoring.
- Providing all necessary measures relating to health and safety at the workplace.
- Raising the level of employee's awareness.
- Analyzing any possible dangers.
- Applying all necessary precautions or actions to avoid or eliminate any potential dangers.
- Implementing risk management plans.

3. Please mention your responsibility at the workplace?

- Operations Operator

Section B: <u>Organisational Experience</u>

1. What aspects of risk assessment framework can be applied at the workplace to determine prospective risks?

- monitoring and examining risk factors
- Developing appropriate plans according to the extent or size of the threat.
- Implementing all necessary precautions for preventing any prospective threats.
- Raising awareness of workers in the field of work in order to avoid any potential hazards.

2. What are the main health and safety aspects of the working environment in your organization?

- Minimizing accidents at the workplace.
- Compliance with the laws of health and safety by workers.
- Control and maintenance of machines.

3. As per your opinion, what are the benefits of implementing health and safety management policies?

- Protecting employees from any potential risks.
- Raising employee's awareness and experience concerning work regulations and safety measures in general.
- Avoiding any delays resulting from Not-applying health and safety measures.
- Raising client's satisfaction.

Section C: Effectiveness of Health and Safety Measures

1. Do you think that Risk management techniques and performance of employees are interrelated? Please elaborate on your answers:

   Yes, effective plans and careful implementation of the risk management techniques by the workers prove the merit of risk management, the cooperation of employees at the workplace and thus the level of occupational health and safety can be raised and risks are reduced to its minimum level.

4. Please elaborate on some major benefits of having proactive planning for risk management in your organization?

   - Minimizing any potential incidents.
   - Avoiding any injuries or deaths at the workplace.
   - Raising productivity and the company reputation.
   - Saving time for the company.
   - Minimizing costs resulting from any incidents.

Interview for upper level management

Small Size Company

Section A: Personal Information

1. What is the designation you hold in your organisation?

   Executive manager

2. How long have you been working in the oil and gas company?

   ٩سنوات

3. What are the roles you play being in the current position regarding the safety on projects?

   المشاركه في رسم القوانين الخاصه بالصحه والسلامه لدى موظفين الشركه والاستفاده من برامج السلامه المهنيه لدى الشركات الكبرى في قطاع البترول والغاز وتنفيذ قوانيين وتشريعات السلامه المهنيه في الدوله والاجتماعات الدوريه لروساء الاقسام والطاقم المتخصص في برامج الصحه والسلامه المهنيه في الشركه والنظر في اخر التقارير الخاصه بذالك الشئن ورسم القرارات المناسبه فيه

Section B: Health and Safety Measures in Oil and Gas Construction Company

1. Why is it important for an oil and gas construction company to undertake health and safety measures for its employees?

   لان العمال في ساحة العمل يكون اقرب الى مواقع الخطر سواء من ناحية الخلل في الالت او ظروف الجو القاسيه من ناحية الحر او البرد او الغبار وكذالك التسربات الكيماويه او الحروق الناتجه عن الانفجارات وغير ذالك

2. What according to you are the measures that need to be taken under the health and safety provision? التاكد من تنفيذ القرارات الخاصه بالصحه والسلامه في ساحة العمل والاشراف على العمال ومراقبة وصيانه الالات ورفع التوعيه لدى العمال

والتطلع الى اخر الاحداثيات والتحديات في قطاع البترول والغاز

وسماع اراى ومتطلبات العمال والموظفين بكل مستوياتهم ومشاركتهم في الاراء

3. What are the main reasons that led you to undertake health and safety measures?

الامتثال للقوانين الدوليه والعالميه

توفير الامن البئي للموظفين

التعاون في المحافظه على البيئه من التلوث

رفع الانتاجيه

رفع الكفائه العماليه

رفع مستوى الصحه والسلامه لدى الشركه

Section C: Effectiveness of Health and Safety Measures

1. To what extent will the health and safety measures help in preventing the accidents occurring at the construction site?

من خلال جودة ادارة المخاطر لدى الشركه وخبرته وكفاءه العمال وتحليل اساب الحوادث ورسم الخطط المناسبه لعدم تكررها

2. In what ways have you benefited by applying health and safety measures in the oil and gas construction company?

كما سبق وذكرنا انا هناك مصالح لشركه وللموظفين والعمال في تطبيق قوانيين وبرامج الصحه والسلامه

فمصالح الشركه هو رفع الانتاجيه لان الحوادث او الخلل في الات والمعدات ذالك قد يوخر عمليات العمل ممايكلف الالف الريالات

وكذالك التعويضات الماليه للعمال في حال حدوث اي حادث او وفاة ناتجة عن خلل في تطبيق برامج الصحه والسلامه في الشركه وزياده الى ذالك تشوه سمعة الشركه

Interview with upper-level management

Small-sized company

Section A: Personal Information

1. What is the designation you hold in your organization?

Executive manager.

2. How long have you been working in the oil and gas company?

I've been working with this company for nine years.

3. What are the roles you play being in the current position regarding the safety on projects?

- Participating in determining the necessary measures for health and safety.
- Benefiting from health and safety programs in large-sized companies in Oil and gas sector.
- Implementing the regulations and laws of the occupational health and safety.
- Holding periodic meetings periodically between all managers and the staff under their command.

Section B: Health and Safety Measures in Oil and Gas Construction Company

1. Why is it important for an oil and gas construction company to undertake health and safety measures for its employees?

Because workers in the workplace are prone to hazards such as machinery malfunctions, harsh working environment, dust, chemical leakages, burns, or bursts.

2. What according to you are the measures that need to be taken under the health and safety provision?

- Listening to employees demands and work requirements.

- Being up-to-date with latest changes and developments in Oil and gas sector.
- Monitoring workers submission and commitment to health and safety measures.
- Monitoring machines performance and maintenance.
- Raising awareness among employees.
-

3. What are the main reasons that led you to undertake health and safety measures?

- Compliance with international and national laws.
- Providing environmental safety for employees.
- Cooperation in saving the environment from pollution.
- Raising the productivity.
- Raising the level of health and safety measures of the company.

Section C: Effectiveness of Health and Safety Measures

1. To what extent will the health and safety measures help in preventing the accidents occurring at the construction site?

They help in doing so by risk management undertaken by the company. The extent of experience and skills of the workers play an important role. Analyzing incidents causes and determining the proper plans to prevent the occurrence of them again in the future.

2. In what ways have you benefited by applying health and safety measures in the oil and gas construction company?

As we mentioned earlier, there are common interests for the company and its employees in applying health and safety measures.

For the company:

- The productivity is increased because any malfunctions lead to delays in production.
- This also averts any financial compensations in case of deaths or injuries occurrence.
- The company reputation can also be affected negatively in the case of any deaths or incidents.

Interview for Middle level management

Small Size Company

Section 1: Personal Information

1. What is the designation you hold in the company?
   Maintenance manger

2. How long have you been working in the oil and gas construction sector?
   ٣سنوات

3. Do you think that there is a need for having proper integration between employees and health and safety management? If yes, please elaborate your answer?
   نعم وانا اعتبرها من اهم الادارات التي لا بد ان تكون علاقتها مفتوحه مع جميع الموظفين لانها خلقت من اجلهم في حل الازامات الصحيه والسلاميه وتوفير البيئه الامنه والسليمه لهم للحدد من الحوادث وذالك ينعكس بالايجاب لدي مصالح الشركه

4. Please indicate the advantages of weekly risk management planning in the organization?
   توفير الخطط الاوليه والوقايه للحدد من الحوادث قبل وقوعها هي من اهم مهامها وكذالك تحديد اسباب المخاطر وحلها ورسم الخطط الوقائيه وتنفيذها التنفيذ السليم وذالك يساعد في فوائد انتاجيه وحفظ التكلفه والوقت وسمعة المنظمه

Section B: <u>Health and Safety Measures</u>

1. What factors need to be considered while undertaking health and safety measures by the company?
   يجب اخذ الاعتبار هل قوانين الصحه والسلامه تنفذ ويعمل بها في جميع انحاء المنظمه هل هذه الاحتيطات شامله لجميع المخاطر بانواعها هل هذه الاحتيطات ذات كفاءه وفعاليه عاليه وذالك يتضح من خلال انخفاض معدلات الحوادث

2. According to you, to what extent the health and safety measures are important to be implemented in the oil and gas construction company?

اعتبرها مهمه جدا من خلال التعاون في للامتثال للقوانيين والانظمه الصحه والسلامه المهنيه

رفع مستوى الانتاجيه

توفير بيئه امنه من ناحية السلامه لدى العمال وبذالك نحافظ على حقوق العمال

رفع مستوى الصحه والسلامه في المنظمه الذي ينعكس على السمعه الايجابيه

Section C: Opinion about Survey

1. Please mention some issues in your organizational regarding health and safety management?

جميع شركات الغاز والبترول تسعي الي الرقي باسمها لان هناك شركات كبرى ومتوسطه وصغرى منافسه

والاقتصاد السعودي يعتمد في الدخل الحكومي علي تلك الشركات وقد يكون هناك تفاوت في التنفيذ الدقيق

للقوانين الصحه والسلامه وذالك اعتمادنا على اسم وحجم الشركات واستثمارتها ودخلها عالميا ومحليا

Interview for Middle-level management

Small Size Company

Section 1: Personal Information

1. What is the designation you hold in the company?

Maintenance manager.

2. How long have you been working in the oil and gas construction sector?

I've been working with this company for three years.

3. Do you think that there is a need for having a proper integration between employees and health and safety management? If yes, please elaborate your answer?

Yes, I think it is the most important department which should have open relations with its employees. It's created for them, so it should face any health or safety issues and thus the company is affected tremendously.

4. Please indicate the advantages of weekly risk management planning in the organization?

This helps in avoiding any incidents before their occurrence. It also helps in determining risk causes, solving them, offering a proper preventative planning, and implementation. The affects the productivity of the company, time, and reputation

Section B: Health and Safety Measures

1. What factors need to be considered while undertaking health and safety measures by the company? Consideration should be taken concerning occupational health and safety rules. They should be implemented all over the organization. This can be evident from the lower level of incidents.

2. According to you, to what extent the health and safety measures are important to be implemented in the oil and gas construction company?

I think it's very important through the following:

- Submitting to the rules and regulations of health and safety.
- Raising the level of productivity.
- Offering a safe working environment for employees and thus protecting employees' rights.

The company reputation is also affected positively.

Section C: Opinion about Survey

1. Please mention some issues in your organizational regarding health and safety management?

All oil and gas companies are trying to raise their reputation because there are competing small, medium, and large-sized companies. The governmental income depends on them and there is a contrast in the implementation and commitment of each company to occupational health and safety measures. And because of that, we depend on the size of the company, its investment locally and internationally.

Interview for lower level management:

Small Size Company

Section A: Personal Information

1. How long have you been working in the oil and gas construction sector?
   سنه واحده

2. Is any action taken by the management related to the prevention of your exposure to health risks at the workplace? If yes please elaborate?

   نعم في بعض الاحيان هناك دورات ميدانيه للتاكد من تنفيذ قوانين الصحه والسلامه للعمال وكذالك لساحة العمل والاات والمعدات

3. Please mention your responsibility at the work place?

   مشرف الصحه والسلامه

Section B: Organisational Experience

1. What aspects of risk assessment framework can be applied at the workplace to determine prospective risks?
   عوامل الاحتيطات الوقائيه من المخاطر مثل اجراس الانذار والطفيات ومخارج الطوارئ والاسعافات الاوليه

2. What are the main health and safety aspects of working environment in your organization?

   التقيد بالابسة الوقائيه في ساحة العمل وقرات البرشورات الخاصه بالسلامهوالمفتشين للعمال وساحة العمل وكتابة التقارير الدوريه وصيانة الالات والمعدات

   التقليل من الحوادث في ساحة العمل والتقيد بقوانين الصحه والسلامه من قبل العمال ومراقبة وصيانة الالات

3. As per your opinion, what are the benefits of implementing health and safety management policies?
   الامتثال لانظمة الشركة لسلامة المهنيه

   الحمايه من الحوداث وحوادث الاعاقه والحروق والحوداث المميته

المحافظه على مستوى الانتاجيه للمنظمه

التقليل من التكاليف الناتجه من التعويضات الماليه للمصابين وتعطل العمل وتاخير الوقت

Section C: Effectiveness of Health and Safety Measures

1. Do you think that Risk management techniques and performance of employees are interrelated? Please elaborate on your answers:
   نعم والمهم في ذالك وعي وفهم الموظفيين للمهام ادارة المخاطر وماذا يجب عليهم فعله لتحقيق الغعاليه

   في العمل والاداء وذالك يكون من خلال الدورات التدريبيه والالقاءات الاجتماعيه بين الاداريين

   والموظفين لشرح نقاط القموض ورفع مستوعى الوعي للموظفين والعمال

2. Please elaborate on some major benefits of having proactive planning for risk management in your organization?
   توفير بيئه عمل خاليه من الحوادث

   المحافظه على سير العمل

   رفع مستوى الكفاءه في الخطط وتنفيذها

رفع مستوى الامان والسلامه لدى الموظفين والعمال وذالك ينعكس على جودة العمليات والتشغيل ورفع الانتاجيه ومستوى السلامه بين الشركات المنافسه

Interview for lower level management:

Small Size Company

Section A: Personal Information

1. How long have you been working in the oil and gas construction sector?

   I've been working with this company for one year.

2. Are there any actions taken by the management related to the prevention of your exposure to health risks in the workplace? If yes please elaborate?

   They offer seminars and training courses to make sure that health and safety measures are applied. They also monitor all minor and major details relating to machinery.

3. Please mention your responsibility at the workplace?

   Health and Safety supervisor.

Section B: Organisational Experience

1. What aspects of risk assessment framework can be applied at the workplace to determine prospective risks?

Risk-protective precautions such as warning bells, fire extinguishers, emergency exits and first aid

2. What are the main health and safety aspects of the working environment in your organization?

- Compliance with the protective measures in the field of work
- Being aware of Brochures relating to occupational health and safety.
- Offering periodic reports.
- Machinery maintenance.
- Reducing incidents at the workplace.
- Commitment to health and safety precautions and measures.

.....

3. As per your opinion, what are the benefits of implementing health and safety management policies?

- Compliance with company regulations for professional safety.
- Protection from accidents, injuries or fatal accidents.
- Maintaining the productivity level of the organization.
- Minimizing the costs resulting from financial compensation for the injured, work disruption and delays resulting from not applying health and safety precautions.

Section C: Effectiveness of Health and Safety Measures

1. Do you think that Risk management techniques and performance of employees are interrelated? Please elaborate on your answers:

Yes, the most important thing is the awareness and understanding of employees concerning risk management tasks. They should be aware of the necessary actions taken in case of danger or emergency and what they should do to raise their productivity. This is done by offering seminars and training courses for them to raise their awareness and experience.

2. Please elaborate on some major benefits of having proactive planning for risk management in your organization?

- Providing a safe working environment.
- Maintaining the workflow.
- Raising competency concerning plans and its implementation.
- Raising the level of occupational health and safety measures taken by employees and workers, and this is reflected in the quality of operations, raising the productivity and the level of peace between the competing companies.

.....